

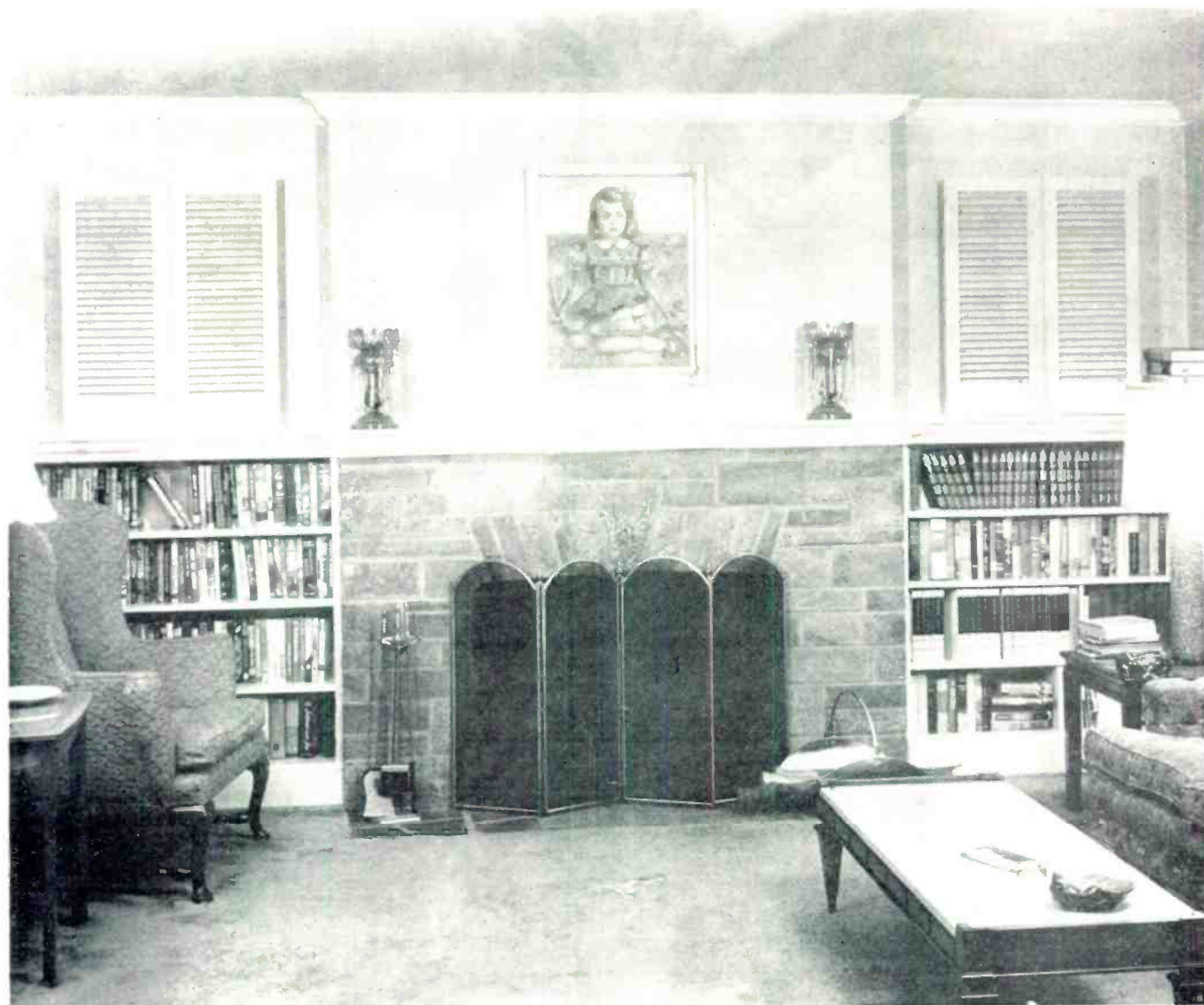
AUDIO

CDC

MARCH, 1964

60¢

...the original magazine about high fidelity!



Behind the louvered doors—loudspeakers page 14

NEW SCOTT TRANSISTOR TUNER MEETS RUGGED MOUNTAIN TEST

High atop Mount Santa Rosa, in California, the Palm Springs Television Company has been using monophonic Scott 310 broadcast monitors to relay FM programs from Los Angeles 105 miles away to the town of Palm Springs, directly behind the mountain. With the advent of stereo, new equipment was needed that would be as reliable as the 310, and provide the same performance . . . now in stereo. After an exhaustive study of available tuners, the brand new Scott 4312 transistorized tuner was selected for the job. Like the 310's they are replacing, the new Scott 4312's will have to undergo a punishing ordeal on the mountain-top. Towering snowdrifts make these tuners completely inaccessible for many months of the year. There is no margin for error . . . these tuners have to work perfectly, with unvarying reliability. They cannot drift even slightly during the entire period.

Robert Beaman, Chief Engineer for Palm Springs Television Company, emphasized the two basic factors in the selection of the Scott 4312:

1. The radically new Solid State circuitry, designed by Scott, provides the optimum in stability and assures years of cool-running, trouble-free performance . . . a must for a remote location like Mount Santa Rosa.
2. New Scott transistor circuitry makes possible three-megacycle detector bandwidth which provides a new standard of stereo separation not previously achieved with vacuum tube tuners.



Here are the seven features that make the Scott 4312 the world's first truly reliable TRANSISTORIZED tuner.

1. Transistorized time-switching multiplex circuitry. Separation in excess of 35 db at 400 cps, a new industry standard.
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5. Sensitive tuning meter and antenna orientation indicator.
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7. Professional slide-rule tuning, with heavily weighted mechanism, and use of ball-bearings throughout. Assures true velvet-touch tuning. \$365*

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Number 7 in a series of discussions
by Electro-Voice engineers



CERAMICS ARE BETTER THAN EVER

HAROLD MOSIER
Chief Cartridge Engineer

Since the advent of stereo, improvements in console and portable phonographs have raised the quality and value of this equipment to the user to heights undreamed of—even by component high fidelity manufacturers—just a few short years ago.

Perhaps most dramatic have been the advances in phono cartridge design for this equipment. The modern E-V ceramic cartridge used in many of today's better stereo consoles rivals the most sophisticated magnetic types in reproduction quality. Yet, despite the improved performance, this new generation of ceramic cartridges better withstands the accidental abuse so often encountered when the entire family uses the phonograph.

The high-compliance, non-destructible needle assembly of E-V cartridges is largely responsible for this improvement. Compliance of 13×10^{-6} cm/dyne is typical of the newest types, yet this cartridge operates modern changer mechanisms with a force of just 2 grams, and will track both vertical and lateral amplitudes as great as .005 cm at less than 1 gram!

This useful high compliance was achieved only after development of a special resolver (yoke) plus long experimentation with materials. The resonance of this needle assembly is damped with controlled impedance to achieve low harmonic distortion and minimum high frequency crosstalk—with consequent improvement in separation. The E-V models offer 30 db separation at 1 kc and 20 db at 10 kc.

Tip mass has also been reduced sharply to minimize high frequency distortion, extend high frequency response, and reduce record wear. And the overall cartridge mass itself has been lowered to under 2 grams. One version of this cartridge becomes—in effect—an extension of the tone arm itself, requiring no shell for protection, but simply plugging into the end of the tone arm to create a uniquely low mass tone arm-cartridge assembly. Other models mount in more conventional fashion with standard dimensions.

Despite this reduction in mass and increase in compliance, sensitivity of E-V ceramic phono cartridges remains high: .3 volt @ 1 kc (velocity = 3.54 cm/sec 45°). This high output permits exact tailoring of frequency response characteristics to the RIAA curve with no need for further equalization. Curves can also be modified to suit the special needs of the phono manufacturer. By every objective criteria the modern ceramic phono cartridge offers an unusually high level of quality for the consumer, plus design flexibility of great value to the phono engineer.

For technical data on any E-V product, write:
ELECTRO-VOICE, INC., Dept. 343A
Buchanan, Michigan 49107



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Coming Next Month

Tape Recording . . .

● Ribbon Microphones for Stereo Recording. E. R. Madsen of Bang and Olufsen in Denmark describes what he considers some advantages of the use of ribbon microphones for stereo recording.

Acoustics

● A Stereo Purist Tackles Room Acoustics. J. W. Linsley. The author, an amateur interested in the best sound reproduction, describes his personal voyage through the difficult subject of acoustics.

Sound Reinforcement Commercial

● A Basic Course in Sound. Norman Crowhurst. (See Editorial Page for description of this course.)

● Controlling Sound-Reinforcement Systems Automatically. David L. Kelpper. The author describes automatic devices for controlling sound-reinforcement systems.

and

Equipment Profiles . . .

● Empire 880p Stereo Pickup

● Electro-Voice Model Six Loudspeaker System

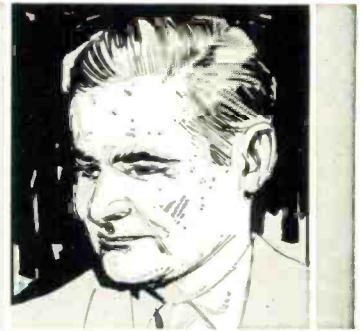
● Altec Lansing Solid State Stereo Amplifier, Model 360A

In the April Issue

On the newsstands, at your favorite audio dealer's, or in your own mailbox.

AUDIO CLINIC

Joseph Giovanelli



Send questions to:

Joseph Giovanelli
2819 Newkirk Ave.
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Include stamped, self-addressed envelope.

Electrolytic Capacitors

Q. Can electrolytic capacitors be successfully used directly from dealer's shelves with reasonable confidence that their capacitances will be within plus or minus ten per cent of their labeled values?

I have been told that electrolytics, when used in an a.c. circuit, should always be used in pairs, in series and back-to-back (making, of course, the appropriate calculations for total capacitance). Is this true? Reid A. Railton, Berkeley, California.

A. Electrolytic capacitors are not reliable as to value. You will be lucky to find them within plus or minus 20 per cent, rather than the ten per cent in which you are interested.

When you use electrolytic capacitors in a.c. circuits, you must connect them in series, back-to-back and calculate the total capacitance in the usual manner. (Back-to-back connection of electrolytics means that they are wired with their positive terminals connected together and their negative terminals on the outer ends of this arrangement being used for the external connections of the resultant capacitor. The result is the same if we connect the two negative terminals together and use the positive terminals as the points to which external connections should be made.)

It is preferable to avoid the use of electrolytic capacitors in such circuits, however. Electrolytic capacitors are meant to work with d.c. voltages applied to them. When d.c. voltages are applied, the capacitor is said to be "formed" and it possesses a certain amount of capacitance. This capacitance varies somewhat, according to the amount of voltage impressed across it. The lower the voltage across it, the larger will be the capacitance of the capacitor, within some limits.

When the d.c. is not present, as in the use you contemplate, one capacitor is formed while the other capacitor in the circuit is reversed. This action will shorten the life of the capacitors, but just how much of a degradation is difficult to estimate. You can use these capacitors in an a.c. circuit but they will not give you the reliability of an oil-filled or a paper unit. These latter types are larger, and where space is at a premium, electrolytics connected in the back-to-back configuration is the only possible configuration.

There are commercially available electrolytic units made in the manner in which you are interested. They are known as NP electrolytics. They are made to look like a single capacitor, but, in reality, they are made in the back-to-back configuration

which we have been discussing. They are used in commercial crossover networks when large values of capacitance are required. They also find application in such equipment as hysteresis motors.

Cathode Follower

Q. I am having difficulty understanding cathode-follower outputs. I understand that a cathode follower is supposed to have a low-impedance output. Most of those I have seen, however, take the output from a 10,000-ohm cathode resistor. This surely is not low impedance. Can you explain this? What would happen if I used low-impedance headphones from the cathode follower output of a tape recording preamplifier which has a 10,000-ohm cathode resistor? Cathode followers are noted for allowing us to use long cable lengths—let's say between a tape recorder and a preamplifier, but 10,000 ohms would present quite a loss, would it not? Robert C. Knosalla, APO, San Francisco, California.

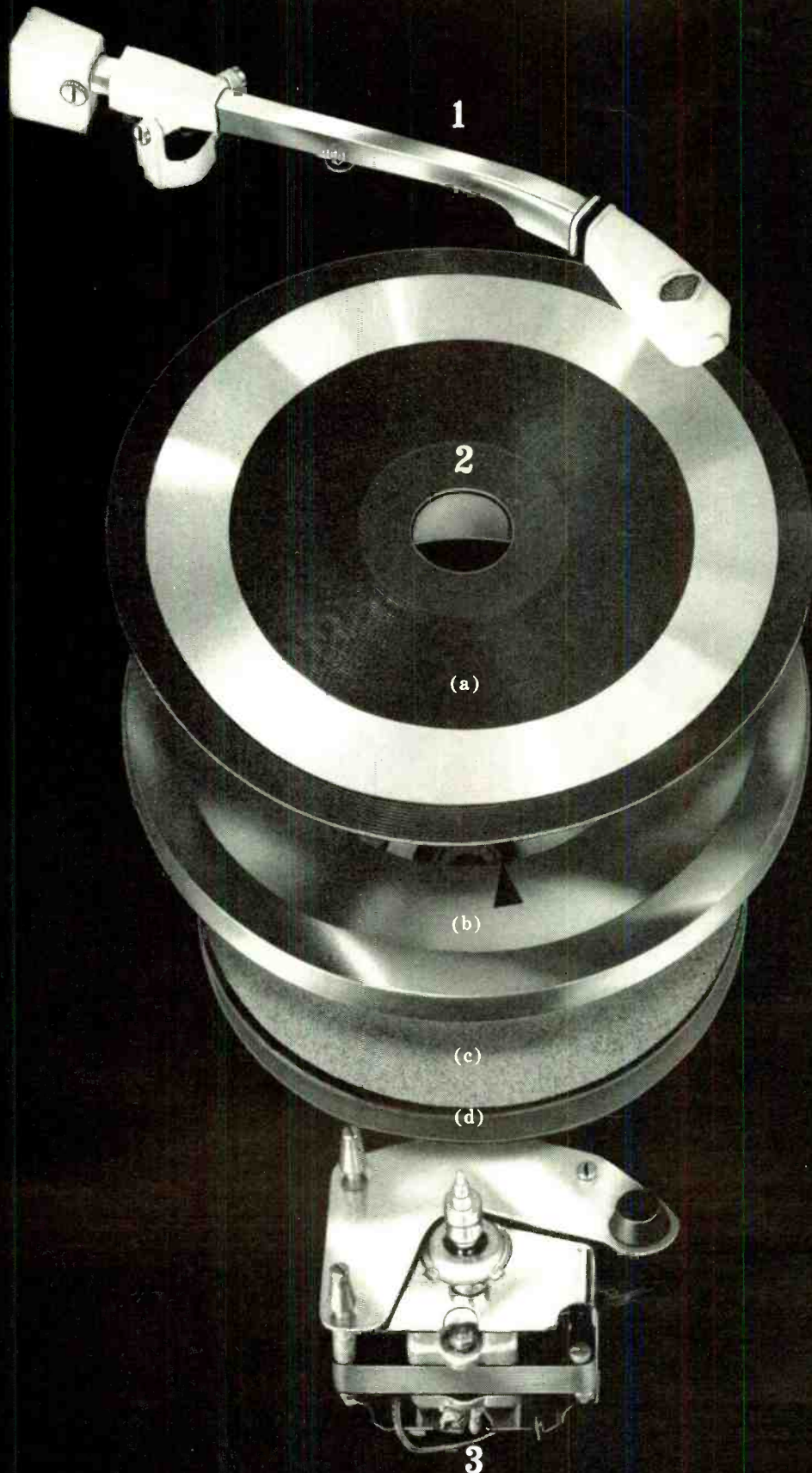
A. It is true that the impedance of a cathode follower is low, even with the relatively high resistance included in the circuit. If you wish to determine the approximate impedance of a cathode follower circuit, connect a VTVM across its output terminals and measure the voltage with a 1000-cps signal feeding into it. Then load down the circuit with a variable resistor until the voltage drops down 6 db. The resistance value of the variable load you have used will give you the approximate value of the cathode follower. (Because of the effects of degenerative feedback in such circuits, the impedance determined will not be exact, but this test may serve to show you that the impedance of a cathode follower is, indeed, very low.)

Remember that the cathode follower circuit is a degenerative device, and the effect of negative feedback is usually that of making the output circuit appear to be of low impedance. The formulas and more detailed theory of such circuits are contained in many reference books and in tube manuals.

However, you normally cannot run low-impedance headphones directly from a cathode follower output because of the small coupling capacitor used with these circuits. Larger values of coupling capacitor are usually not required because, while the cathode follower exhibits low impedance, the load into which they feed is of higher impedance, and a smaller capacitor will operate very well and not cause voltage divider action at the low frequencies. If you plan to use the cathode follower circuit to drive a pair of headphones, you must increase the value of the coupling capacitor so that its reactance to the lowest audio frequency to be passed is equal to the impedance of the phones. You should not attempt to use phones whose impedance are lower than that of the cathode follower. 600-ohm headphones are about the lowest practical limit you can expect to use.

consider this... with other units
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so special?



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However, these are only parts, and record playing units by other manufacturers offer some features reminiscent of these.

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Creative engineering, rigid quality control, and 50 years of experience have joined together to make the Garrard an enduring source of satisfaction and pride to a legion of sophisticated admirers.

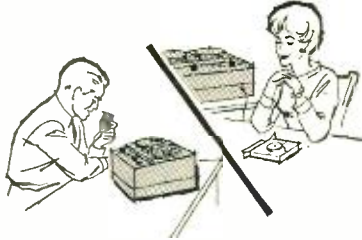
You'll find the Garrard a genuine pleasure to own. Over the years, your dealer has found it the same pleasure to recommend. That's why more people continue to buy Garrard than any other high fidelity component. They buy it for precision, for performance and to enjoy the convenience of single and automatic play, both at their fingertips.

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WHY you should buy and enjoy TARZIAN TAPE

■ Most of its users say that Tarzian Tape is the finest tape you can buy for the entire range of audio recording purposes, from stereo music to school work. Tape dealers who sell Tarzian Tape do so because they believe it is a very good product for you, the user—not because we give them fancy advertising support and free premiums.

ITEM	Reel Size	Length (Feet)	Code Number
Standard Play 1.5 Mil Acetate Tape	3"	150	1131-01
	5"	600	1131-06
	7"	1200	1131-12
	Reel Hub	2400 2400	1131-24R 1131-24H
Long Play 1.0 Mil Acetate Tape	3"	225	1121-02
	5"	900	1121-09
	7"	1800	1121-18
	Reel Hub	3600 3600	1121-36R 1121-36H
Long Play 1.0 Mil Mylar Tape	3"	225	1321-02
	5"	900	1321-09
	7"	1800	1321-18
	Reel Hub	3600 3600	1321-36R 1321-36H
Extra Long Play 0.5 Mil Mylar Tape (Tensilized)	3"	300	1411-03
	3 3/4"	600	1411-06
	5"	1200	1411-12
	7"	2400	1411-24

The package for Tarzian Tape is strictly functional, not ornate. The price is standard: not cheap like "white box," not artificially high because of some "magic ingredient." The quality is professional, not because you run a recording studio or a radio station, but because any good tape recorder deserves it and any discriminating pair of ears appreciates it.

Insist on Tarzian Tape... depend on it for long lasting, professional quality performance whatever your recording assignment.

FREE... Tarzian's "Lower the Cost of Fun With Tape Recording" contains 32 illustrated pages of tape tips. Send for your free copy.

Unfortunately a larger capacitor which will work well with the phones may not work well with amplifiers with which this circuit may be associated. Low-frequency transients may charge the coupling capacitor to such a degree that the grid which it feeds may be cut off. Because of its large value and because of the high grid leak in the amplifier, this grid will remain blocked for some time.

In view of the foregoing discussion you now understand that a cathode follower is truly a low-impedance device. Therefore, long cables may be used between the cathode follower and the equipment it feeds. This is possible because the capacitive reactance in the interconnecting cable is high compared to the impedance of the cathode follower.

Balanced and Unbalanced Circuits

Q. What is the purpose of using two-conductor shielded cable for microphones instead of single-conductor shielded cable? What do people mean by a "balanced line" as referring to inputs to amplifiers? What is the purpose of grounding the core of an input transformer? What do manufacturers mean by balanced input transformers? What is the advantage of a balanced input? Robert C. Knosalla, APO, San Francisco, California.

A. First, let us take the case of the conventional, high-impedance microphone which has two terminals, one for the "hot" input and one for the ground connection to the circuit to be driven from the microphone. You can use single-conductor shielded cable with such a microphone and it will work fairly well under most circumstances. However, there may be a trace of hum. When the microphone possesses low output and high impedance, there will almost surely be too much hum. The greater the length of the cable between microphone and preamplifier, the greater will be the hum voltage. To prevent or reduce this hum, connect the shield to one end of the circuit and ground. This connection is made at the preamplifier end of the line. In other words, the "hot" lead from the microphone is connected as before. The ground side of the microphone is connected to a second conductor of a two-conductor, shielded cable, and goes directly to the microphone input ground. The shield is not connected to the microphone element. Thus, the shield is not made to double as a signal carrier and can operate exclusively to reduce hum. If the shield is grounded at the microphone end, it is both possible and probable that there would be a difference of potential between one end of the shield and the other. This voltage difference would have a complete path and would modulate the input stage of the equipment. However, when the shield is connected at one end only, voltages developed from one end of the cable to the other do not have a return path and cannot cause hum.

Sometimes this hum reduction is carried one step further. Assume now that we have an input stage to which we connect the secondary of a transformer. One end of the secondary is grounded and the other end goes to the grid of the input stage. Even though the run is short between the transformer and grid, it is good practice to use two-conductor as has been described. The primary of the transformer may be center-tapped. This center is grounded. However, sometimes the transformer is not so equipped, in which event the two ends of the transformer primary are connected to the end of the microphone cable with neither side of this winding grounded. This cable is two-conductor, shielded cable. The shield is grounded to the input stage at the proper

(Continued on page 14)



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**Buddy Cole: Modern Pipe Organ
Warner Bros. WS 1533**

The Warner Bros. label has been the source of some of the very finest organ records I've had the pleasure of hearing in recent years. This release arrived for review while the cover of Audio's January '64 issue with its ton-and-a-quarter speaker system was uppermost on the pile of magazines that adjoins my listening chair. Before this disc appeared, I too had been wondering what sort of recent record I'd like to hear first on such a system. The author of the article, it's true, doesn't think much of records as an ideal sound source, preferring instead two-track 7.5 and 15 ips stereo tapes of his own making as the best material for his concrete horns. We can't argue with him there. If, like most of us, you are forced to deal with ordinary commercial releases, this latest Warner disc has at least one point in common with theories for concrete speaker horns. "Modern Pipe Organ" is the first recording made at Buddy Cole's own recording studio just opened in North Hollywood, California. Two years in construction, the studio was planned for organ recording with concrete walls eight inches thick. Once your speaker concrete is dry, this is the record to get—provided your pickup can do justice to the clean, wide-range sound on the disc. The organ Buddy Cole has assembled was originally more than one instrument. The central part is an 18-rank Wurliitzer taken from a Los Angeles theater in 1959. To this was added a 9-rank Robert Morton that had seen service at United Artists studios and a Los Angeles radio station. Now part of his home, it has been housed in ultra-modern studios designed for stereo recording of this particular instrument. If you like to play your organ recordings at something approaching theater level, you'll appreciate the fact that Cole has placed the noisy mechanical parts of the organ on the floor below the recording studio. With no studio rental fees to worry about, it is possible to believe Cole's contention that the master tape was two months in the making as he put the organ through its sonic paces in a varied program of ballads and a percussion specialty. If you pride yourself on the tightly authentic bass response in your system, slip this one on the next time the neighbors are away.

**Lady in the Dark
Columbia OS 2390**

Columbia Records continues to earn the gratitude of dyed-in-the-wool theater fans with its truly outstanding re-creations of some of the great musicals of the past. While this label can hardly be accused of ignoring the current Broadway scene, its carefully planned revivals on records are unique within a highly competitive industry. Kurt Weill's "Lady in the Dark," with lyrics by Ira Gershwin and book by Moss Hart, is an important landmark in our theater all but unknown to the expense-account set supporting most of today's musicals. Back in 1941, two years before "Oklahoma" made Broadway history, this sumptuous production marked a fairly daring departure from the musicals of its day as it set psychoanalysis to music. Since the idea for the show came into being after Moss Hart had completed four years undergoing analysis with the celebrated Dr. Gregory Zilhoorg, it could be said that this was one time Hart had a collaborator from outside the theatrical world. What also set apart "Lady in the Dark" from its contemporaries was the richly

LIGHT LISTENING

Chester Santon

imaginative music of Kurt Weill and the penetrating lyrics of Ira Gershwin. In this recreation for records, Rise Stevens plays the neurotic heroine originally created on Broadway by Gertrude Lawrence and Adolph Green takes over the role that first brought fame to Danny Kaye. The task of editing this show for records has been a remarkably easy one because music is heard only during the dream sequences. The four major dreams of the heroine that make up most of the plot are neatly contained on one record. Columbia has lavished extra care on every detail of this production with Lehman Engel in charge of a fine cast as well as the original Kurt Weill orchestrations.

Al Hirt and Ann-Margret: Beauty and the Beerd

RCA Victor LSP 2690

Someone at RCA Victor has made the pleasant discovery that trumpeter Al Hirt can be coaxed into singing duets when his partner happens to be a young and pretty girl. Ann-Margret's pert contribution to this album won't surprise anyone who has seen her movies or heard her earlier RCA discs. The shock of discovery here comes in the benign good humor with which Al Hirt uses his gravelly voice in the lyrics of such old favorites as *Tain't What You Do* and *Baby, It's Cold Outside*. Optimum channel separation and very close miking of the two stars underlines the vocals when Hirt isn't playing his trumpet with an eight-piece combo. This album could be the start of a new and quite separate career for the Bearded One.

Grenadier Guards: Pomp and Circumstance

London Tape LPM 70074

In its latest tape the Band of the Grenadier Guards presents a collection of marches that duplicates in some respects the repertory of a recent Columbia tape by the Philadelphia Orchestra titled "A Festival of Marches." Comparison of the two reels may hold little interest for readers who decided some time ago that disc reproduction has it all over four-track tape. Those committed to tape will be intrigued to hear that London, seldom a slouch in either their tape or disc sound, has been surpassed by Columbia in this particular reel release. Quite apart from the natural advantages of the far greater manpower mustered by a symphony orchestra, the Philadelphia on Columbia has a distinctly wider frequency response throughout its reel.

**Frank Chacksfield: Here's Love
London Tape LPM 70077**

Although it's difficult to make an accurate prediction in the case of each Broadway musical, some record and tape fans hold the opinion that no final judgment should be made on a major show on the basis of the original cast album. Their reasoning runs something like this. As a rule, the arrangements of the finished score are worked out under considerable pressure while the show is in rehearsal. Songsmiths have been known to pull a song out of a show and throw in a new one while the production is undergoing tryouts out of town. The arranger has little opportunity to dress up a tune under such circumstances. Once a musical hits Broadway and survives the tender attention of the critics, other arrangers take a look at the score and begin to work on it with a bit more leisure for employers such

as Kostelanetz, Faith, Melachrino etc. In his latest London tape, Frank Chacksfield has turned to Roland Shaw for arrangements of the rollicking Meredith Willson tunes in "Here's Love." Shaw is a rising young talent in England already represented by a tape of his own on the London Phase 4 label (Mexico L 74030). He lends an air of smartness to the Macy's-Gimbels' battle at Christmas time that the original cast album didn't quite bring out.

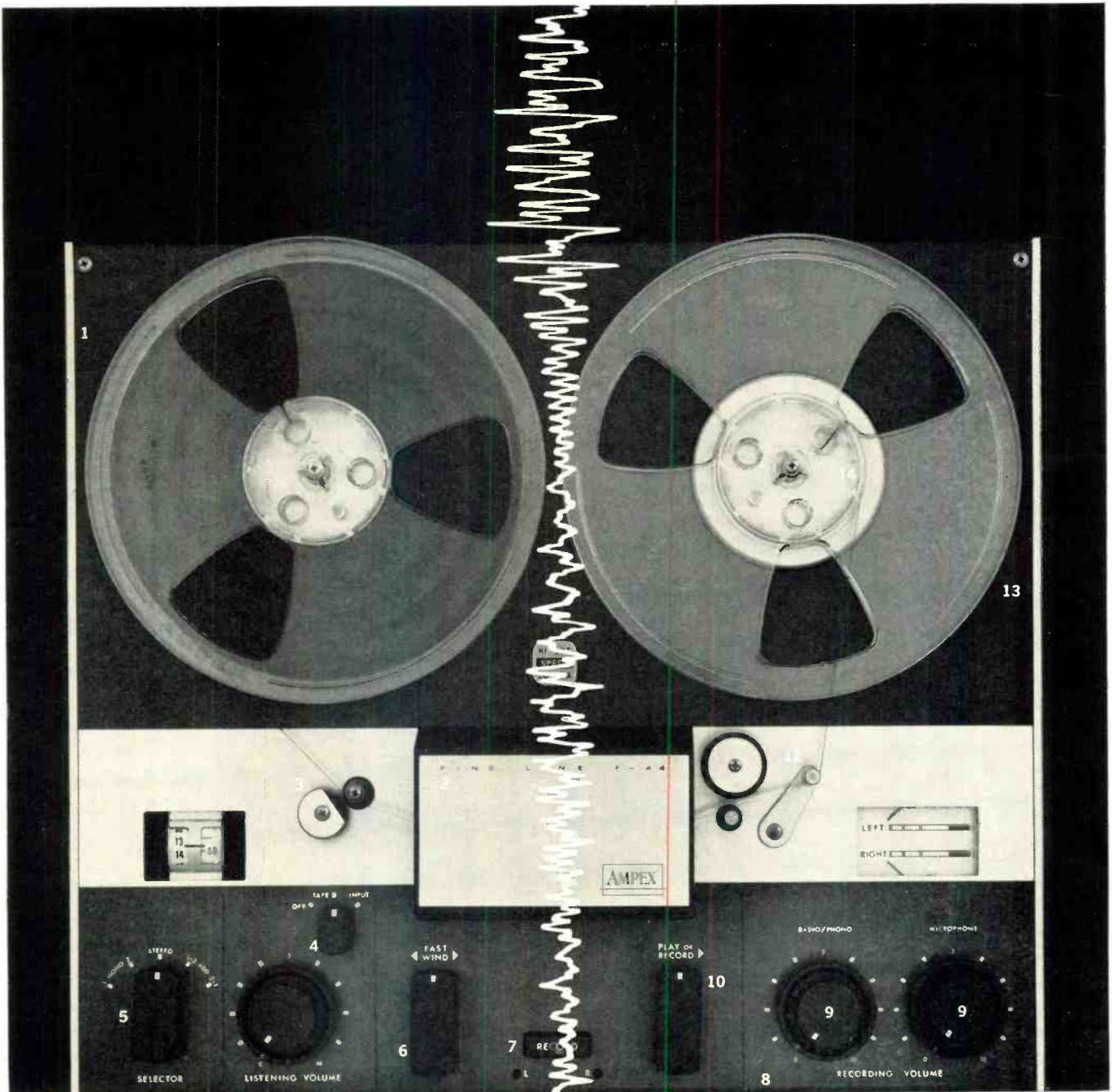
Hall High Dance Band: Pops and All That Jazz

LPH-1001

Don't look for this stereo disc in record stores. This is a private pressing for which the Hall High School of West Hartford, Connecticut supplied the youthful talent. Bill Stanley, the director of the school's dance band and jazz chorus, submitted the disc for review in this column as an example of the work being done by hep music departments in our more progressive communities. Because the recording session took place in the studios of Capitol Records in New York City, the project offers a good opportunity to compare Capitol's current custom work with the effort that goes into its regular "store" recordings. It doesn't take long to discover that this is not a commercial release. The raw wallop of the sound reminds one again how much doctoring goes into the final sound of today's typical pop record. Since even West Hartford lacks a budget that would allow fancy equalization of the master recording after the session, one can hear Capitol's equipment (17 Neuman, Sony and Telefunken mikes) pretty much as it sounded in the control room during the session. The finished record can be played with the preamp's tone controls in a flat position, a rare event in these days of arbitrary theory in recording curves. The large orchestra and 30-piece mixed chorus show no sign of hesitation in tackling intricate arrangements that cover the pop field from Afro-Cuban to Basie, with occasional echoes of Ray Conniff and Stan Kenton. Stereo balance is not bad considering the impromptu nature of the session. After listening to a whole disc of "straight" sound, one can not help wondering how the top bands under contract to Capitol would sound under similar circumstances.

**Henry Mancini: Charade
RCA Victor LSP 2755**

Caught in a moment of candor, anyone reviewing light music on records could be prevailed upon to make the following admission: motion picture scores these days break down into three groups, only one of them offering dependable entertainment. When heard without the benefit of picture, about seventy percent of motion picture albums are empty to the point of boredom. Another twenty percent of contemporary picture scores are pompous beyond belief when isolated from the Technicolor pageantry on the screen. Luckily for all concerned, the remaining ten percent contain enough entertainment and diversion to make the whole thing seem worthwhile. In that remaining ten percent, the scores of Henry Mancini occupy a far more prominent place than his seniority in the field would indicate. Where occasionally I would find myself reaching for a book, magazine or crossword puzzle to get even part way through a motion picture score, this recording of the made-in-Paris "Charade" held considerable attention all the way. The brevity of the disc itself may have had something to do with it. The first side runs about fifteen minutes; the other side isn't much longer. Mancini touches just about all bases in this film starring Cary Grant and Audrey Hepburn. In the title song he has a potential hit that could easily rival the success of his famous *Moon River*. Close behind it in melodic appeal comes a song describing the Seine river boat called *Bateau Mouché*. The French mountain resort of Mégève is the only locale outside Paris described by Mancini. A classical string quartet is used at one point in the story to provide a funeral touch. At the other extreme is the witty *Drip-Dry Waltz* that accompanies a scene wherein Cary Grant takes a shower with his clothes on. ZE

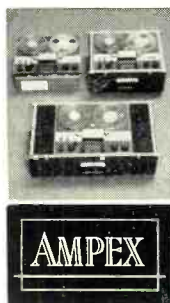


Fourteen ways to save money on your next tape recorder

Before you buy, compare the features of the Ampex F-44 with those of any other recorder in its price range. Note the features the F-44 has that the others don't. Then compare price, and you'll see what a bargain the F-44 actually is. In fact, if you can find a better bargain, buy it. **1) Professional Electronics.** Each F-44 recorder is individually tuned and adjusted by Ampex technicians to meet or exceed the following standards: Overall frequency response 50-15,000 cps \pm 2db at 7½ ips; 50-10,000 cps + 2-4 db at 3¾ ips. Signal-to-noise ratio: better than 53 db. Flutter and wow: 0.12% rms at 7½ ips; 0.18% rms at 3¾ ips. **2) Three separate heads.** Each head in the F-44 is built to perform its own individual task (recording, playing or erasing), with no compromise of purpose in attempting to make one head serve several functions. Precision engineered head shielding virtually eliminates crosstalk. **3) Advanced tape-tension system** eliminates the use of pressure pads, by feeding tape or transporting it past the

heads under constant tension adjusted at the factory. **4) New, separate power and monitor switch** makes it possible to monitor both source and playback while you're recording. **5) Master selector switch** permits simple changes from stereo to mono, choice of individual track, multiple generation sound-on-sound-on-sound.

6) and 10) New compartmentalized mode-to-mode controls. Two knobs control all transport actions, permit going from one mode to another quickly and safely. **7) Record indicator lights.** One for each channel. **8) Die-cast frame.** Micro-milled for meticulous alignment. **9) Built-in mixer,** with separate volume controls for recording of 4 inputs. **11) Separate record level meters.** **12) Exclusive unattended shut-off.** **13) New hysteresis synchronous motor.** **14) Automatic tape take-up.** Makes threading easy. For brochure, write Ampex Corporation, Consumer and Educational Products Division, 2201-C Landmeier Road, Elk Grove Village, Illinois. In Canada, Ampex of Canada Ltd., Rexdale, Ontario.



There is no such thing as the one best amplifier.

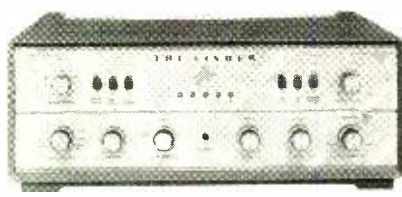
There are at least five.



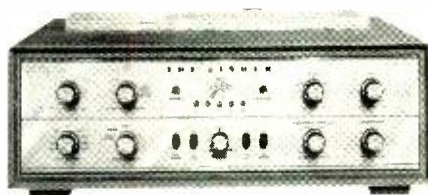
The Fisher X-100-B (50 watts), \$169.50*



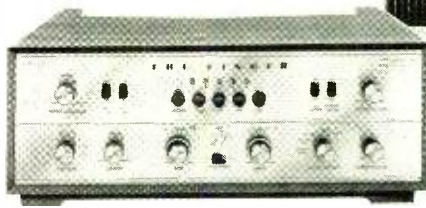
The Fisher X-101-C (60 watts), \$199.50*



The Fisher X-202-B (80 watts), \$249.50*



The Fisher X-1000 (110 watts), \$339.50*



The Fisher 400-CX and SA-1000 (150 watts), \$199.50* and \$329.50*

The five different Fisher amplifier systems currently available were *all* engineered to be the best, bar none. A self-contradiction? Not when you get down to fundamentals.

The basic function of an audio amplifier is to effect signal gain without distortion or noise. The lowest-priced Fisher amplifier accomplishes that task as successfully within its power rating as the costliest. There is only a single Fisher standard of amplifier performance: clean, 'open' sound, with complete stability regardless of the load, and virtually non-measurable distortion right up to the clipping point.

Thus, as you go up the scale from the Fisher X-100-B through the other three integrated control-amplifiers to the professional 400-CX/SA-1000 combination, you

will *not* hear cleaner and cleaner sound — at least not at ordinary listening levels in the average room with reasonably efficient speakers. What you *will* experience is the convenience of increasingly elaborate control features, greater flexibility in special situations and — above all — more and more power handling capability. The workmanship and the quality of parts is the same in all Fisher amplifiers. And the unique Fisher warranty (one year, *including* tubes and diodes) applies equally to all models.

You can forget about quality when you choose your Fisher amplifier. Concentrate on your needs with regard to power, flexibility and space. No matter which Fisher you finally select, it will be *the* best.

*Less cabinet; slightly higher in the Far West.

FREE! \$1.00 VALUE!

Mail this coupon for your free copy of the new 1964 Fisher Handbook, a lavishly illustrated 52-page reference guide to stereo.

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Fisher Handbook



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The Fisher

LETTERS



**PORTABLE...
PRECISION-MADE!**

NEW BUTOBA model MT-7F



Lowest priced modern, battery operated, transistorized portable of superb quality — ideal for music or speech. Built-in remote control facility . . . stop-start switching on the microphone for dictation in the office or car!

SPECIFICATIONS:

Records 2 full hours • Power supply: rechargeable battery, or 6/12 V car battery, or AC converter • Push buttons enable easy operation while in carrying case • Safety record lock • Microphone and Radio Phono inputs • Headphones/external speaker connections • Pause control • 3 $\frac{3}{4}$ and 1 $\frac{1}{2}$ ips. • Frequency response: 100-12,000 cycles at 3 $\frac{3}{4}$ ips. • Recording level indicator • 4" x 6" heavy duty loudspeaker • Transistorized speed regulator.

BUTOBA model MT-5



BUTOBA is a precision tape recorder, quality-engineered and hand-crafted by skilled West German technicians, offering performance and features never before found in portable recorders! **New Reduced Price!**

UNEQUALLED FEATURES:

6 hrs. recording on 5 inch reels • Fast forward and rewind • 2 motors with transistorized electronic speed control • tone control • push-pull amplifier • 5" x 7" heavy-duty speaker • Tape counter • 40 hrs. on 8 ordinary flashlight batteries • Transistorized, battery or AC.

SPECIFICATIONS:

Response: 50-13,000 cps. @ 3 $\frac{3}{4}$ ips., 60-6,000 cps. @ 1 $\frac{1}{2}$ ips. • Half track • Compact • Lightweight • With dynamic mike • Full line of accessories.

BOOKLET FREE!
"25 WAYS TO USE YOUR TAPE RECORDER" and color folder. Yours for the asking. Write . . .

STANFORD INTERNATIONAL
569 Laurel Street • San Carlos, Calif.
Telephone: 591-0339

Contradictory Conclusions in Pike

SIR:

I have read Mr. Pike's article, "Organs and Organ Music," with interest. I find his conclusions about the acoustical environment and "chorus effect" contradictory. I agree with the acoustical portion. I would also suggest that his residence organ, if it doesn't include a reverberation feature (or an extremely large auditorium) does not sound realistic. At least it doesn't sound the same as the composers had intended it for their compositions. Electronic organs can now be made with reverberation controls which allow the room size to be made large enough to be realistic.

Electronic organs exist because of their economies of size and money. I find that even the cheapest of the better organs available today sound better than the harmoniums of an earlier day. Electronics has discovered how to separate the pitch generation from the tone generation of the organ. Even our best pipe organ builders can't get around that. When an electronic organ builder starts to imitate a pipe organ with a combined pitch- and tone-generator system, the electronic costs more. We have even the reaction of people like Mr. Pike who feel that imperfections such as the finite time it takes for a pipe to sound after the air is admitted is a virtue. If we carried his "45 different attack times" to its logical conclusion, we would go back to either a completely pneumatic pipe organ with no relays, or as some other purists to a tracker action. Mr. Pike would probably like the manufacturer who has gone to great expense to provide a "chiff" with his electronic organ.

Mr. Pike's article is informative and well written, but I couldn't resist this opportunity to heckle.

JOHN SHAVER
1333 Cushman Dr.
Sierra Vista, Arizona 85635

Vertical Tracking Angle—Better Way

SIR:

In my article "15-Degree Vertical Angle—A Key to Better Stereo Sound," I stated that the best way to measure the vertical tracking angle of a pickup is by use of the CBS Laboratories' STR-111 Square Wave and Intermodulation Test Record. There have been new developments since this statement was made.

At the International Convention of Audio Engineering Society in October, 1963, we announced a new technical test record, the STR-160 Vertical Tracking Angle Test. This record contains

15 bands of 400-cps tone, cut in a vertical recorded angle varying in calibrated steps from -6 degrees to +43 degrees. To measure the vertical recorded angle the record is played normally while the second harmonic content of the pickup output is measured with a harmonic analyzer or a 800-cps filter. The band which shows minimum distortion identifies the vertical tracking angle of the pickup.

While the new record confirms the vertical tracking angle measurements obtained with the STR-111, it cuts down to a small fraction the time and equipment required to perform the measurement.

B. B. BAUER
CBS Laboratories
Stamford, Conn.

Sources of CDS Cells

SIR:

As a result of the number of inquiries relative to my article in the November issue ("Remote Control With Light") I should like to request that the following information be published:

The Polaris MAJ-1 cadmium-sulphide cell may be purchased for approximately \$2.00 each from either of the below listed firms: 1. Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Illinois. 2. Polaris Electronic Corp., 17 E. Pershing Road, Kansas City, Missouri.

WILLIAM G. DILLEY
577 East Avery Street
San Bernardino, Calif.

Resistive Loudspeaker?

SIR:

I must protest at least one part of the crossover-network transient-performance article by Robert Mitchell which appeared in the January issue. The author assumes a resistive loudspeaker. Any text on speakers soon makes evident that the device is far from being a pure resistance.

The transfer functions shown as Eq. 1(A) and 1(B) make no provision for the frequency-dependent nature of the speaker. The equations are therefore invalid to the study of the transient response of a crossover network with a loudspeaker load.

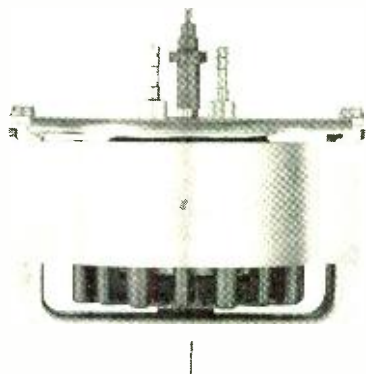
When frequency dependence is accounted for the problem becomes very complex and no simple solution is immediately evident.

ROBERT FRANK, JR.
16841 Vanowen St.
Van Nuys, Calif.

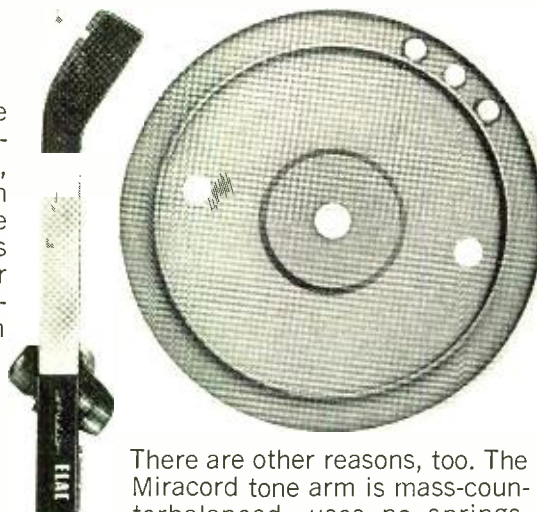
world's only automatic with hysteresis-synchronous motor



Only the Miracord 10H offers you the speed reliability of the famous Papst hysteresis motor, the one used in the finest studio turntables and tape transports.



Speed-synchronized to power-line frequency, the hysteresis motor rotates at a constant, accurate rpm, even with extreme variations in voltage and load conditions. The smooth, steady motion this imparts to the turntable is one of the major reasons for the distinctively natural quality of sound associated with the Miracord 10H



There are other reasons, too. The Miracord tone arm is mass-counterbalanced—uses no springs. Sensitively suspended on friction-free, micro-ball bearings, it is freely responsive in every plane. The turntables are heavy, one-piece, precision-machined die castings. Each is 12" in diameter, and each individually weighted and adjusted for dynamic balance.



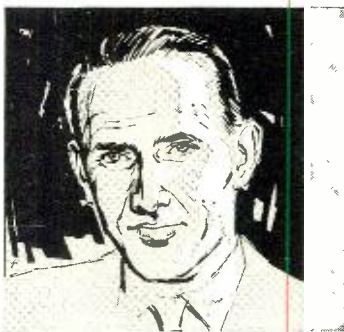
Furthermore, the Miracord can be used as a manual turntable, automatic turntable, automatic record repeater or automatic record changer. It is incredibly gentle to your records, and amazingly easy to use. Four FEATHER-TOUCH push buttons reduce all automatic operations to utter simplicity.

The Miracord 10H with Papst hysteresis motor is \$99.50; Model 10 with 4-pole induction motor, \$89.50 (less cartridge and base). To hear a Miracord at its best, ask your dealer to demonstrate it with the new Elac cartridge: the Stereo 322 or Mono/Stereo 222. For details, write:

Benjamin Electronic Sound Corp., 80 Swalm Street, Westbury, New York
BENJAMIN MIRACORD
 sole U.S. distributor for Miracord turntables, Elac cartridges, and other Electroacoustic® audio components.

AUDIO ETC.

Edward Tainall Canby



A. ON THE DOTTED LINE

I have a furtive habit, lately growing upon me, of signing those little cards you find at the hi-fi shows saying "If you wish further information . . ." or "I want to know MORE about your wonderful products." Works wonders, mostly unpredictable. For, you see, by this means I bypass big brass and become one of those ever-interesting people, a Potential Customer.

What usually happens is that after a few weeks of utter silence (during which the digestive process has been churning madly away at those cards, stacks and stacks of them), I get some preliminary mail, often of congratulatory sort. "Congratulations for your interest in our Product!" I accept these congrats, of course, with all proper humility, as my rightful due. After all, I had to use my own ball-point pen, didn't I? Big job, filling out those endless forms, covering my entire name, address, street number, postal zone and what-have-you, all in a space as big as two special delivery stamps. I deserve thanks, I think.

Then I begin getting more mail, from my friends all over the industry. Big names! People I've known, more or less, these many years. Only in person they often call me Ed; whereas now I'm getting addressed ever so respectfully as Dear (printed) Mr. Canby (typed-in). Funny, they act as though they'd never even met me.

Greenwich Street

And then the fun really begins. I begin receiving mail from total strangers. Some of them don't even acknowledge the source of their sudden interest in me but I can guess easily enough. Especially when the name is misspelled in a tell-tale way. (I didn't misspell it; they misread it.) For instance, Mr. E. P. Conby of Greenwhich Street, New York, begins to get quantities of mail unheard-of and the Post Office at New York 14 (rebaptized as New York 10014) gets hotter and hotter under the collar, until the time comes when the mailman refuses to deliver *any* further letters addressed to Greenwhich Street. No such street in Minhattin, dammit!—And they still come.

(The above is literally fictitious; but the P.O. does get hot under the collar about Greenwich Avenue, versus Greenwich Street. We have both. The Office is uncharitable with out-of-towners who use the wrong one and periodically sends all the mail back, though the mailman knows perfectly well which is intended.)

Once in a while, after the initial signing of the little card at the hi-fi show, I get an all-out commercial pitch that actually explains itself. I treasure these, and especially when they offer me info I really wanted to acquire. For instance (and here will take off Part B of this article), a coupla days ago I received a very fat letter

from an old friend of mine (a telephone friend, at least) which began, as usual, with that formality I have come to recognize as the inevitable product of any signature I leave in a box at a hi-fi show. "E. T. Canby, 780 Greenwich St New York 14, N.Y." correctly typed in. "Dear Mr. Canby," also typed in. Then in nice, black offset, "Your name has been given to us by," and typed in again, "ELPA MARKETING IND. Inc. (Thorens)," followed by more nice, black offset, "as being interested in their products." Signed in nice, black offset by William Colbert of the Audio Exchange, Jamaica 32, N. Y., who would undoubtedly call me Ed if he weren't talking in black offset.

Good to hear from you, Bill, and I was precisely glad to find, via much accompanying literature, that the Audio Exchange is still doin' fine, after a good many years in business.

I also have suddenly found myself addressed by an outfit called Boynton Studio, in Tuckahoe, N. Y., and by an obvious close-relative, Boynton-Goodall Audio of Eastchester, N. Y. Then there's a fat newsletter from an outfit I used to know many years ago (they say they are in their "58th year of Reliability" (which, happily, is more than I can say of myself), Rabson's—57th Street, Diagonally Opposite Carnegie Hall, New York. Wow! Dozens of pages of offset from Rabson's, all crammed with hi-fi. "Thank You for Your Interest in Rabson's," says the first page with the utmost clairvoyance—since I hadn't previously shown the slightest interest in Rabson's, and more fool me. I'm showing it now.

I'm indebted to Rabson's, for example, because I know now that in addition to Scotch, Irish and maybe Welch magnetic recording tape we currently may buy something called American tape, which offers with typical American largesse a new "professional length" that gives you more. Twenty-five per cent more, indeed. Good to know if you're one of those guys who run off the end of the tapes all the time, like I do. Nothing Scotch about American.

Audiophile vs. Net?

I'm also agreeably surprised by a much more far-reaching innovation, first time I've seen it, in the Rabson newsletter. Rabson's (and hence presumably many another hi-fi source) has split the audiophile-net price rating right down the middle.

You see, that term originally came in at the beginning of modern hi-fi, with the expansion of the old-time radio parts outlets into the new-style retail direct-to-customer sales outlets. Those old terms "list" and "net" obstinately held on, until in order to quell a rising consumer sense of utter confusion, somebody happily invented the term "audiophile net," which said in so many words—yes, there's still a List Price and some people are still paying it; but for you, our own hi-fi customer, we'll charge only the net price. You save. And of course, you did. Audiophile Net was a good idea.

But now we go further. Rabson's has two price columns. One is headed "Audiophile." The other says "Net." Now you guess what *that* means. And guess which is the lower. Take a look.

Well, it beats me. For instance, a well known stereo cartridge of recent vintage is listed at \$39.50 "Audiophile." Its "Net" price is \$14.99. Another cartridge, of similar vintage, is Audiophile \$35.00. The Net price is \$7.90. I'm learning fast. Aren't we all?

So, next time you're at a hi-fi show, be sure to sign every one of those little cards they provide for you. Never can tell what they may bring you.

B. SECOND-HAND, ANYONE?

What really interested me in these assorted returns, all from a single signature on my part, was confirmation that an old idea which I had espoused a good many years ago is still on the march. Trade-Ins. Second hand hi-fi equipment.

I've always felt that a secondary hi-fi market would be a superbly useful idea for the consumer, even though I have been aware all along that there are technological complications and economic complications that work against the idea from the seller's point of view, making it at best a borderline operation.

The hi-fi market has been built to a large extent upon the enthusiasm of those who are interested in quick change, who must have the newest, who feel it necessary to get rid of present equipment just as soon as the novelty has departed—which is soon. If it were not for these people, hi-fi would not have developed as fast as it has, and I mean this quite seriously.

More fool the guy who plunges into everything that's new—he's asking for trouble. On the other hand, if he didn't, where would we be?

New Market

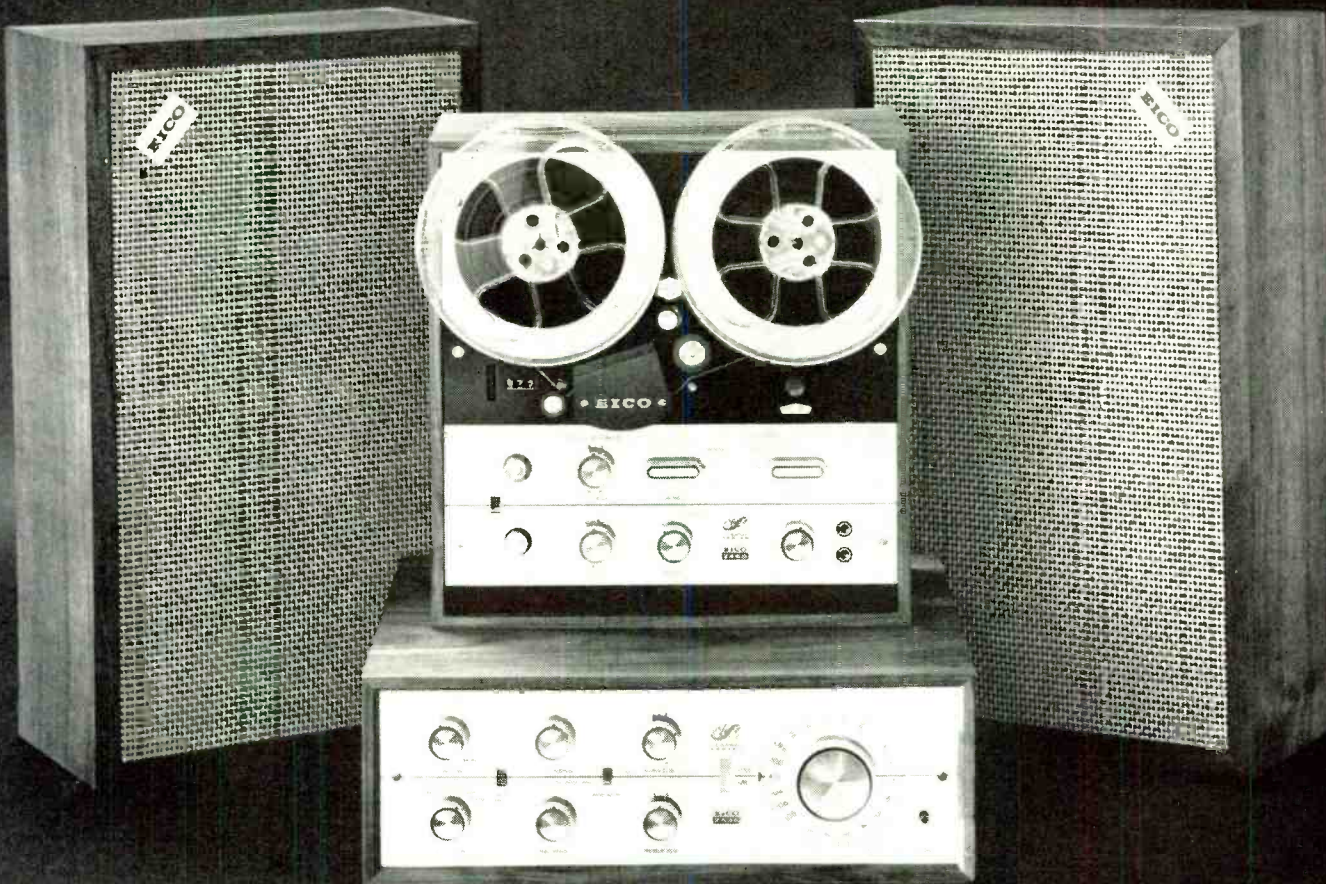
Our recklessly rapid progress, our brilliant progress (when you come down to it), very often comes from just this sort of curiosity among stalwart Americans with cash to spend. As I see it, the quick development and perfection of new products in this country is largely dependent on a market of people who are willing to try new things. For if people didn't buy our new products, we couldn't afford to launch them. And because they do in fact buy with enthusiasm, we are given a double boost.

First, we can *anticipate* a ready sale of new production; and so we can afford to go all-out where a more cautious economy might balk, go timid, stagnate in the tried-and-true.

Second, we can *improve and perfect*, because we are always able to finance improvement through sales of early models—with all their probable and inevitable faults—to the eternal optimists in the hi-fi market. The shake-down period is crucial to good production and reliable quality. Somebody has to pay for it. The consumer pays, and likes it. Like it enough of the time, in any case, to feel justified in more expenditures and still more, over and over again. Wonderful system.

Now nobody will ever persuade me to buy an early-model car, in particular a new model-line. I'm wary, wise, cautious, and I don't have dough to splurge. But I'm atypical. Others buy, and risk it. They get paid off in prestige, in any case, even if troubles do develop, as they may. Same in hi-fi. What we are talking about, you see, is the old principle of *risk*—though most economists, if I am right, apply that principle to the manufacturer, to the capi-

An FM tape stereo system of comparable quality would cost up to \$850



start with the Eico receiver kit — only \$154.95

You can build a complete, high quality FM tape stereo system from the new Eico Classic Speed Kit package for only \$445. This system includes the Classic 2400 stereo/mono 4-track tape recorder; Classic 2536 FM MX stereo receiver and two HFS-8 2-way high fidelity speaker systems.

Completely wired you'd save nearly \$300 on this system over other makes of comparable quality—factory wired price \$570. You can also select any individual component at a remarkably low price.

Here's why it's so easy to build these superb components. The 2400 tape recorder comes with the transport completely assembled and tested—only the electrical controls and amplifiers need be wired. The 2536, is without doubt the easiest-to-build receiver ever designed. The front end and the IF strip of the tuner section are supplied completely pre-wired and pre-aligned, and high quality circuit board and pre-aligned coils are provided for the stereo demodulator circuit. Speaker systems are completely assembled in fine oiled finish walnut cabinet.

EICO CLASSIC 2400 STEREO/MONO 4-TRACK TAPE RECORDER Performance on a par with recorders selling at twice the price. 3 motor design enables each motor to be optimized for its particular function.

□ 3 heavy-duty 4-pole motors, capstan motor with integral fan □ DC braking of reel motors □ Standby operation between all transport modes prevents tape spillage, provides slur-free starts, permits easy cueing & editing □ Automatic end-of-tape switch & digital counter □ Jam-proof belt shift mechanism selects 7½ or 3¾ ips speed. □ Requires no head wearing pressure pads □ New combination erase and record-play

4-track stereo head □ Equalization selector provides uncompromised equalization on both speeds. □ Mixing mike and line level controls □ Dual electron-ray level indicator tubes □ Made in U.S.A. □ Oiled finish walnut base incl. in price of both semi-kit and wired versions. Semi-kit (transport assembled & tested) \$199.95; wired \$269.95.

EICO CLASSIC 2536 FM-MULTIPLEX STEREO RECEIVER Makes every other stereo receiver seem overpriced. Combines stable sensitive FM stereo tuner *plus* a virtually distortion-free 36-watt stereo amplifier with remarkable overload, transient and regulation characteristics.

AMPLIFIER SECTION □ all program sources—magnetic phono, adapted ceramic phono, tuner, tape □ Full control facilities—bass, treble, blend and balance □ Tape monitor switch □ Distortion at 10-w/channel 40 cps—0.5%; 11HF, power bandwidth at 1% distortion, 30 cps—20 kc.

TUNER SECTION □ Low noise, shielded & temperature compensated front-end for drift-free performance □ 4 amplifier-limiter stages & ultra-wide-band ratio detector. □ Electron-ray tuning bar & stereo program indicator □ Velvet-smooth rotary tuning □ IHF usable sensitivity 3 μv (30db quieting); 1.5 μv (20db quieting). □ IHF distortion 0.6%; IHF capture ratio 3db. Kit \$154.95; wired \$209.95 (Incl. FET)

EICO HFS-8 2-WAY SPEAKER SYSTEM Compact 2-way speaker system in handsome oiled finish walnut cabinet. Full transparent bass; clean, smooth middles and highs. Two speakers: 8" high-gap energy woofer-mid-range transducer, and matched 2" tweeter. Wired only, \$44.95.



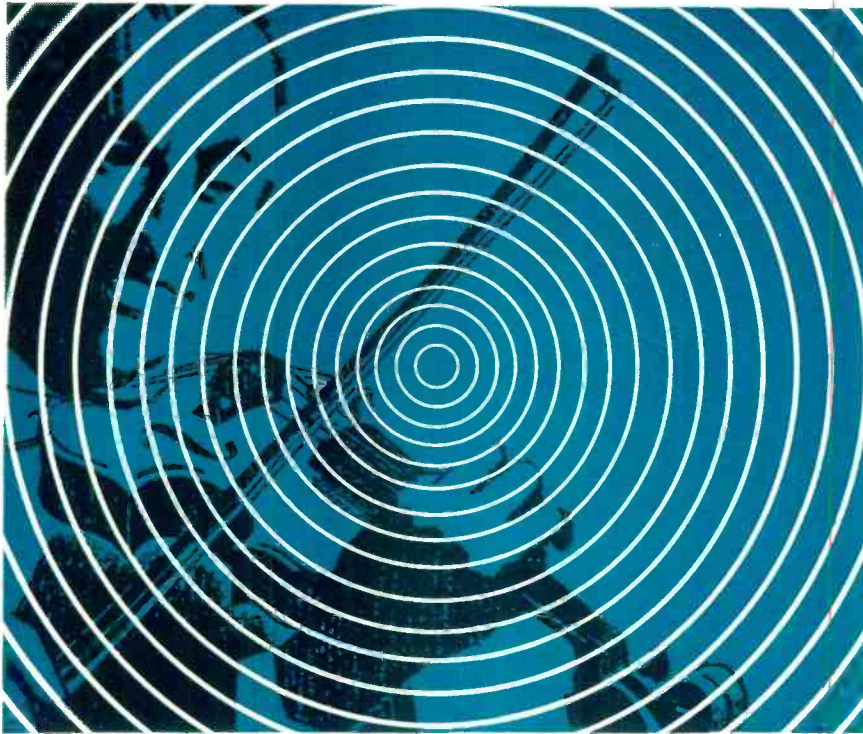
OTHER NEW EICO CLASSIC SERIES COMPONENTS 2036—36 watt stereo amplifier. Kit \$79.95; wired \$109.95. 2200—FM/MX Stereo Tuner. Kit \$92.50; wired \$119.95 (Incl. FET.) 2050—50-watt stereo amplifier. Kit \$92.50; wired \$129.95. 2080—80-watt stereo amplifier. Kit \$112.50; wired \$159.95. Optional oiled finish walnut cabinet for the 2036, 2036, 2200, 2050 and 2080 are available for \$19.95. Add 5% in West



FREE 1964 CATALOG
Dept. A-3



Eico Electronic Instrument Co., Inc., 131-01 39th Ave., Flushing, N.Y. 11352 Export: Roburn Agencies, 431 Greenwich St., N.Y. 13, N.Y.



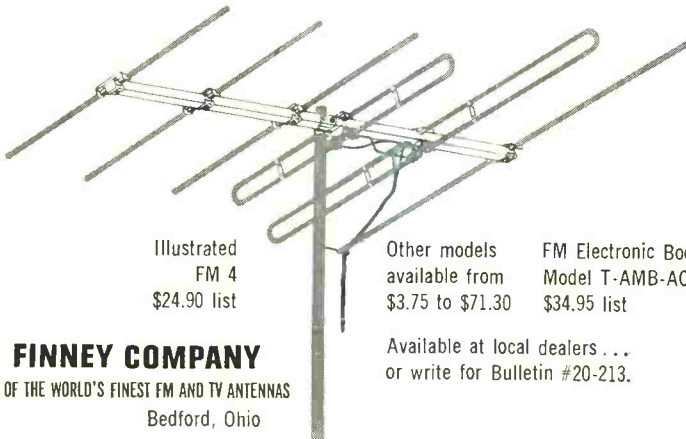
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AWARD-WINNING FM ANTENNA

Broadcasting authorities agree that an outdoor antenna is absolutely essential for the reception of full quality monaural and multiplex FM sound.

A *FINCO* FM antenna will deliver a clean, undistorted signal and bring in more stations, regardless of location.

Guarantee yourself the best seat in the house for tonight's FM concert . . . install a fidelity-phased *FINCO* FM antenna.



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FM Electronic Booster
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Available at local dealers . . .
or write for Bulletin #20-213.

THE FINNEY COMPANY
PRODUCERS OF THE WORLD'S FINEST FM AND TV ANTENNAS
Bedford, Ohio

talist, rather than to the consumer. Comme ci comme ça, as the French say. Six to one, half dozen to the other. Risk is the soul of healthy buying.

Border-line Market

Why are trade-ins a border-line type of activity in hi-fi? Simple enough. Because hi-fi products lie right on the dividing line between low-cost and high-cost goods.

Low-cost products are disposable, in various senses. Not worth fussing about as second-hand goods. Get a new one. Economically, it isn't worth the time and trouble to repair, to guarantee and to go through all the complex, over-head-producing motions of selling second hand low-cost goods, unless in charity rummage sales and the like where the overhead is removed via voluntary work forces. Who buys old shoes, arctics, repaired umbrellas, second-hand snow-shovels, rebuilt toasters, used suits, second-hand blankets? In our economy of abundance, approve or no, you can't make a profit on such items.

At the opposite extreme, take houses and real estate. A house can actually increase in value over the years and may sell very nicely second hand. Nobody ever heard of brand new real estate, at least not since the pioneer days; it's always second hand, if often radically improved. Manhattan island was bought second hand from the Indians, Louisiana Territory from the French—that was quite a second-hand bargain. And we got Florida second hand too, plus a few more choice used items that went to make up the present U.S.A.

And in the middle—autos. They represent the ideal second hand market, not too expensive and yet not too cheap. If all of our new hi-fi sold in the \$2000-up price range, we'd have a whale of a second-hand market. Instead, it sells in the \$100-up range. A lot more than shoes and toasters, and a serious investment for many people. A lot less, though, than the cheapest auto. Right on the border-line.

People will tell you that the reason we have no very great second hand hi-fi market, and no very extensive trade-in policy as yet, is because nobody trusts second hand goods. Buy new, they say, and be sure.

Hogwash! Sorry to disagree. I do go along with that idea to an extent when it comes to autos, which are too often treated like mud during their first-owner lifetimes. (I will not buy *any* second hand car for my own commuting-to-schedule in and around New York's busy parkways.) But when it comes to hi-fi I snort loudly, Again, hogwash.

I think, things being as they are, that I would trust goods coming from a reliable second-hand specialist who *does* take in trade-ins just as readily as I would trust brand new goods from a non-trade-in outlet.

Yes, you can get stung. But you are more likely to get legitimate second-hand bargains. It's in the cards. As we all should know, component hi-fi boasts an over-all reliability that is intrinsic, built-in, exclusive of bugs and faults that aren't supposed to be there. Component goods are basically long-time performers. Unlike autos, they seldom get really rough treatment. Thus with minor intelligent adjustments, realignments, replacements of parts, they often go on and on, for years. Far longer than most cars ever do.

Here is a kind of performance, variably to be sure, that is statistically built into most hi-fi—and yet we go right on selling brand new models in quantity, year after year. A lot of these go to new owners in an ever-expanding market (we hope). But a



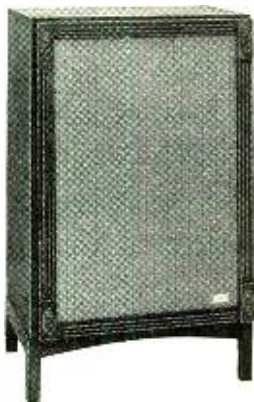
"A Medallion..."

1



is a Medallion...

2



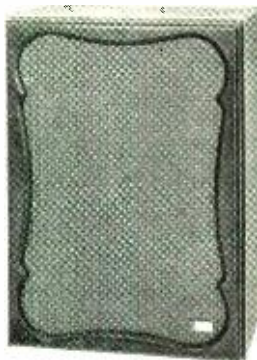
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5

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- 2. *Contemporary*
- 3. *Italian Provincial*
- 4. *Early American*
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lot go to the old customers, a million or so of them, who are replacing former equipment with the latest. What happens to their old units? They can't just throw them out.

Swap-and-Trade

As things are now, most of them enter a kind of unofficial underground swap-and-trade system that flourishes non-commercially in the hi-fi underbrush all over the place. Most of it is via word of mouth, through casual personal contacts. (I caught one of my Canby Singers selling his old amplifier the other day—he said he always buys new, every year. Sold it to a guy upstairs, on the spot in two minutes, right in front of me.) A lot gets filtered around through want-ad columns and those convenient hi-fi exchange and general buy-and-sell departments that you'll find in magazines, newspapers, even on assorted bulletin boards. Nobody's taking a commission (except for space rates); nobody is guaranteeing anything in writing, nor are the repairs more than happenstances. Yet the great selling goes on—it has to. There's value galore here. The stuff is far from junk!

Decidedly, then, there is a need for organized second hand hi-fi and for the accompanying trade-in arrangements that tie the old to the new, a need that can be filled if the economics can be worked out, if the responsibility for proper checking and reconditioning can be met, if the business can be run reputably, to build customer confidence. It is unwise, I'd say, to argue any other viewpoint, unless you imply that all second hand men are crooks and vice versa.

Facts of Life

The whole idea of second-hand hi-fi, then, depends on a knowledgeable and a reputable approach to the problems of handling

the material. First, there must be accurate and fair appraisal and quick, efficient reconditioning, things decidedly possible for those with a bit of brainpower behind their finger work. We have the brains lying around, all over the place. Good work in this area breeds good repute and customer happiness.

Second, there must be a very careful approach to the problem of organizing the service, of publicizing it; and this is a tough job, where a million honest mistakes are easy to make. For, once again, the hi-fi second hand area is a marginal one, right on the borderline of feasibility. To make it go you'll have to combine exceptional honesty—you'll be suspect before you even start—with exceptional technical know-how and an unusually canny business sense. No small requirement! But the goods are there, waiting, and so is the demand.

If you are tops in these respects, you see, you may build advantage upon the facts of hi-fi life—for we do not drive amplifiers the way we drive cars; they have fewer moving parts and mostly they just sit, piling up the hours and months until, one day, second-handedness arrives.

I must observe at this point, if I dare, that most hi-fi is traded in with only those faults inherent in the original design. If they plague us, those faults, it is not second-handedness that is to blame but first-hand deficiencies, right in the manufacturer's sealed carton. Nobody's perfect and nobody can be; the standard guarantee is the maker's offering of penitence for being less than angelic and it is a good one. New hi-fi, all in all, remains a miracle-production, with all its faults. We're lucky to get it as good as it is.

And so don't go slamming old hi-fi. It's the same stuff, remember, and neither more nor less reputable in the large. Just used.

AUDIOCLINIC

(from page 4)

point. The end of the shield at the microphone end of the cable is grounded to the microphone case. Notice that with this arrangement the shield is again not carrying signal. With this arrangement, too, the hum which may be induced into the line will be introduced in the same phase into each conductor of the inner pair of conductors. Thus, the hum produced in one wire is cancelled by the same hum produced in the other. This scheme is known as a "balanced line." Such a line is used in either input or output stages. In addition, the circuits are low-impedance circuits, further reducing the effects of hum voltages. If one end of the primary was grounded, the circuit would then become an unbalanced line. In fact, the first two circuits described here were examples of unbalanced lines because ground was located at one side of the circuit rather than at the centertap.

The core of an input transformer is grounded so that the hum induced into the transformer case cannot be transferred to the transformer winding. This ground does not aid in the suppression of hum developed by magnetic induction into the windings, but prevents hum from entering as the result of capacitive coupling. This is logical when you consider that the core and case are separated from the windings by an insulator, and that two conductors separated by an insulator is exactly what you have when you have a capacitor. Grounding the case and the transformer core will place any hum voltages at ground potential, rendering them less effective as hum producers.

COVER STORY

The installation shown on the cover this month is in the home of Mr. Eugene Setel, 42 Chatham Ave., Buffalo, N. Y. The turntable is a Garrard "A," the speakers Electro-Voice 12TRXB, the AM-FM-MPX dual amplifier a Bogen RP-230. Shuttered louvers now conceal the 12-in. triaxial speakers and small windows above the bookcases. An archway on the right, (not shown) leads to the dining area where the equipment



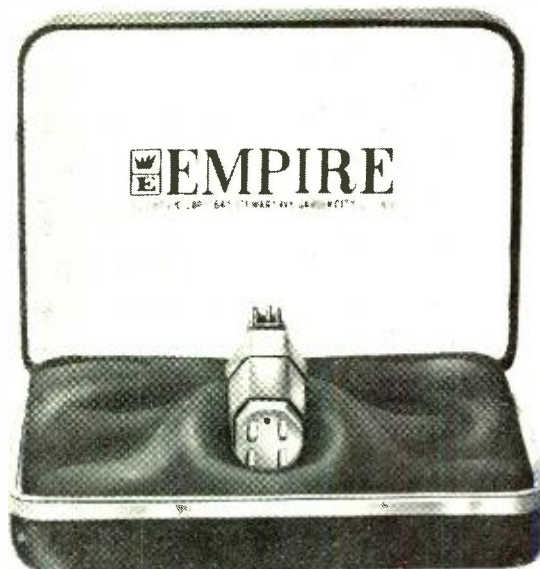
(shown above) is located. The cabinet-work is by A. L. DiChristopher. Installation by Dick Levy of Seneca Audio-Visual Corp., Buffalo, N. Y.

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"Most Musical"
"High Compliance"

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tinue to come. Judged by audiophile experts the world over, the Empire 880p is one of the finest cartridges made to date. Leading authorities don't expect a better one for the next 10-20 years.

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*Reported by a Leading Independent Testing Laboratory
 †Stereophile Magazine, Wallingford, Penn.
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EDITOR'S REVIEW

FULL CIRCLE

MANY YEARS AGO, when high fidelity as an industry was not yet "invented", the serious listener had to smuggle equipment from the broadcast and motion picture studios, or build it himself. The commercial equipment available to him was usually of such poor quality that much of the musical quality of a performance was lost.

Gradually, up through the middle Forties, ever more people heard about and obtained amplifiers, loudspeakers, transcription turntables, and so forth. Still, there were relatively few who had even heard of the component way to better sound reproduction.

After World War II the pace started to quicken and many more companies and individuals became involved. Somewhere along the line the name "high fidelity" became attached to this method of taking separate components and assembling them into a system for sound reproduction.

The thread that tied all this history together was the desire and attempt to get ever-better sound reproduction, ever-more faithful to a live musical performance under ideal conditions.

Of course, not all companies produced the top quality equipment, some produced good quality instead. After all, not everyone could afford the top quality. But within this variation, from good to excellent, the over-all direction in quality from year-to-year was up.

That direction has changed somewhat in recent years; now product lines go sideways and downwards in quality, rarely up. Now the attempt is to fill in all price categories so that a "full line" is offered. Naturally, the area which had been neglected by high fidelity manufacturers in the past was the "fair" and "passable" categories, and these are the areas being filled-in.

This trend is especially noticeable in loudspeakers. In recent months there has been a veritable rash of new very-low-priced loudspeaker systems. One would hardly class the quality of many of these new entries within three orders of magnitude of the more expensive systems available in the marketplace, some by the same companies making the low-priced units.

Why?

Apparently in an attempt to enlarge the audience for component high fidelity by making the cost "reasonable," and in the belief that once exposed to components the new audience will inevitably proceed up the quality ladder.

It hardly seems reasonable to us that one could convince a "virgin" audience by putting ones worst foot forward. In essence the neophyte is being exposed to the poorest-quality sound component systems can offer, certainly no better than many non-component manufacturers are offering, and is supposed to be convinced from that that components are better. Poor logic.

If this downward trend continues, we may well arrive at the place we started from with top-quality systems owned by a few, and the rest owning systems which lose most of the musical quality.

Full circle.

NOT CONVINCED

RECENTLY WE ATTENDED A CONCERT at Philharmonic Hall in New York City wherein the negative attitude of performers towards sound reinforcement systems was demonstrated—to their loss.

It was a concert of classical guitar, an instrument

whose beauty lies in its delicate and expressive voice. Certainly not an instrument to project in large spaces such as Philharmonic Hall.

Normally one would think of sound reinforcement in such a situation. Unfortunately the performers vetoed the idea. Unfortunate for them, and the audience. They just didn't project well enough. Here is a case where performers actually harmed their performance because of a lack of trust in the reinforcement system.

In a way we don't blame them for being reluctant about using sound reinforcement. Many places where performances are given have less than perfect reinforcement systems—much less than perfect. Usually such systems impart a special sound of their own to the performance, above and beyond what the performer intended. The entire sound-reinforcement profession has been given a "black ear" by these systems, to the extent that most performers would risk "doing without" in marginal situations such as the one described.

To change the attitude of performers towards sound reinforcement will require many years and many fine reinforcement systems. It will require the services of sound-system installers who are much more than electronics experts; they must be able to evaluate properly the acoustic problem, and be able to tell the musical difference.

(By the way, the house system at Philharmonic Hall is quite fine. The performance would have been helped considerably if it had been used.)

SPEAKING OF SOUND REINFORCEMENT

STARTING IN APRIL we will present a series of "lectures" by Norman Crowhurst on this very subject.

The course will consist of just under a dozen lessons, each designed to impart some useful information about sound reinforcement, with questions (and answers) at the end of each lesson. Typical sound system situations will be presented and discussed, and possible solutions given.

The reason for this course lies partly in the situation we have just described in the preceding section, and partly to provide our readers with a useful set of tools if they wish to engage in sound reinforcement professionally or as an amateur (churches, lodges, school plays, and so on).

The course is aimed at readers who have some knowledge about sound reproduction but are not specifically familiar with the problems involved in sound reinforcement.

Of course there is no need to introduce the instructor to the readers of *AUDIO*, he has been writing articles for us for many years. We would like to point out his special qualifications in this area however. Mr. Crowhurst was employed for a goodly number of years by one of the better loudspeaker manufacturers in his native England. He has been responsible for solving many problems related to the matching of a loudspeaker to a specific environment, one of the key skills required for good sound reinforcement.

THE LOS ANGELES HIGH FIDELITY SHOW

For those readers who missed our notice last month, the Los Angeles High Fidelity Show will take place at the same stand as last year, the Ambassador Hotel, from March 11-15. Come on down, the weather will be great. (And the products too!)



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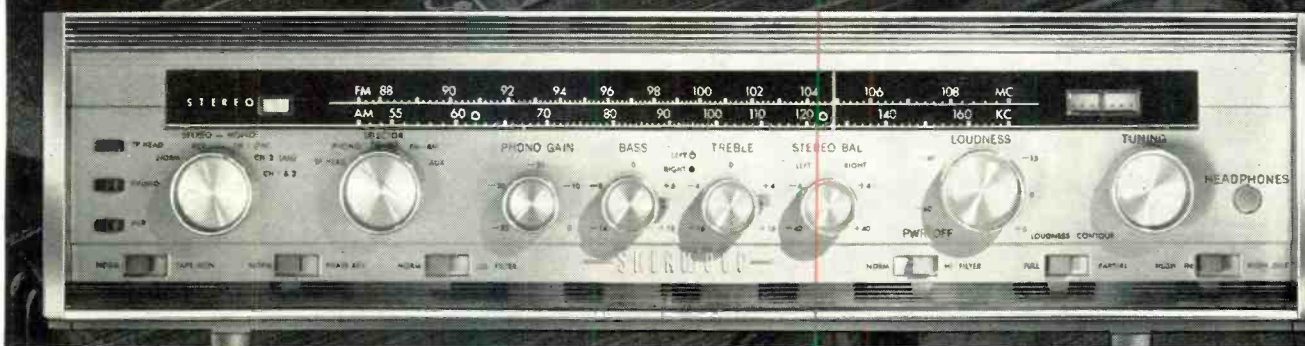
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AUDIO • MARCH, 1964

17

Are separate
tuners and
amplifiers passé ?



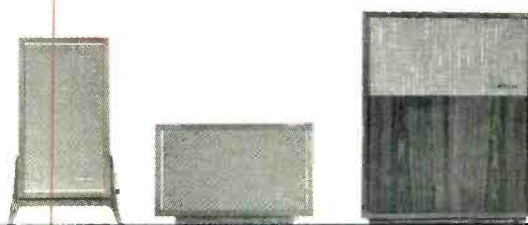
An outstanding new combined tuner/amplifier component . . . the S-7700II AM/FM/FM Stereo 80-watt Receiver.

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Recording a Community Music Festival

GIL DANEY*

The Alaska Festival of Music is an annual event spanning almost three weeks with a variety of different musical events, including chamber music, folk concerts, vocal performance, electronic music, and full symphony orchestra plus full chorus. All this is recorded every year by a crew of amateurs for instructional and critical purposes. Here is the story from the viewpoint of the recording engineer.

THERE ARE TWO OF US, Mr. Marvin Kirschbaum whose "matched ears" are only surpassed by his delicate touch on the audio mix gains, and myself, whose long legs and long arms are advantageous in swinging from rafter to rafter. We have been recording the Anchorage Community Chorus and Anchorage Symphony concerts, as well as the Annual Alaska Festival of Music for nigh on 7 years or more. Mr. Kirschbaum runs a clothing establishment and puts in 8 hours a day. I work for the FAA, and with both of us working six days a week during the two weeks of Festival events, and then recording in the evening, we are in the same sleepy class with the Chorus and Orchestra members, most of whom also put in a full day before rehearsals.

As an example of "Recording in Anchorage," let us take you through the

* 2100 Lord Baranof, Anchorage, Alaska.

1962 7th Annual Alaska Festival of Music.

First Steps

The Festival Committee first obtained approval from the American Federation of Musicians Union for recording for playback, an important and necessary first step. Distribution of copies was restricted to guest artists or performers, and playback confined to those members in accordance with Union regulations. Thus, in June the culmination of 11 months of preparation by approximately 1000 community-spirited citizens began with the arrival of Robert Shaw, Julius Herford, Danny Lewis, and various guest artists. While Mr. Herford held classes in Music Appreciation with the Symphony, and the Chorus, and lectured on KTVA/TV daily; Mr. Danny Lewis rehearsed the Festival Orchestra in the West High School auditorium; Miss

Elvera Voth rehearsed her 120-voice Anchorage Community Chorus in the upstairs bandroom; individual guests practiced in the Sidney Laurence Auditorium in the afternoons and performed their individual concerts there nightly and also held classes on TV and at the West High School.

The main concerts and rehearsals were held in the West High Auditorium and required two Sonys and two Neumann U47's with an E-V654 as spare, an Ampex mixer (MX35), Ampex 354 recorder (stereo of course), and a small Berlant 505 or Sony 777 as backup. Naturally there were playbacks of some rehearsals and concerts in the afternoons for dynamic and balance comparisons for those who requested them. This left two Berlant 30's, one at each home, for use in checking the various recorded sounds in the wee hours (equipment-wise) and left only the daytime sessions by Mr. Herford unrecorded; very unfortunate, since these sessions are literally the heart of the concerts and the Festival.

Three years previously, the decision had been reached as to placement and approximate gains to be applied to each microphone, if and when condenser microphones 3 and 4 and a mixer were financed. In 1962 we achieved that happy condition, with the Anchorage Symphony Orchestra and Anchorage Community Chorus concerts (just prior to the Festival) available for a good 4-mike recording check.

The Recording Phase

Thus began the recording phase. Previous Festival programs, pictures (one of these days I'm going to treat the photographer), and orchestra programs were perused for microphone distances and gain settings; \$100.00 worth of Lo-print tape, all virgin or bulk erased, was run through and loosened up; stick tabs were made up for marking and identifying reels; all tubes and equipment were checked; recorders were aligned and bias



Fig. 1. The Orchestra and Chorus after the final concert. Note sketched-in locations of microphones.

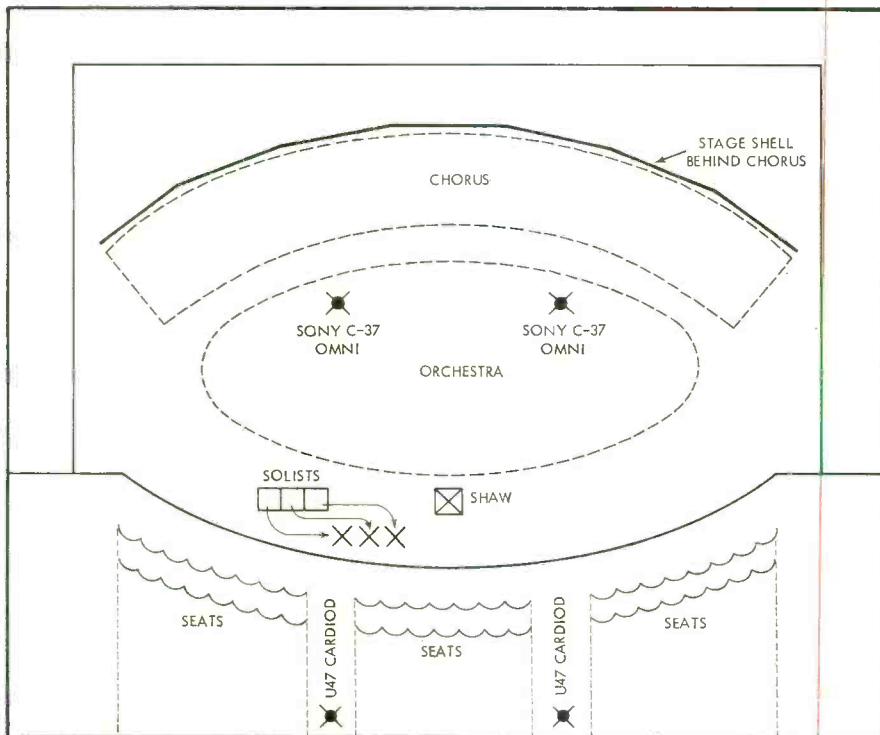


Fig. 2. Plan view of auditorium showing location of orchestra, chorus, and microphones.

settings reset (the Ampex had such beautiful response that some response was sacrificed while resetting so that both channels would be perfectly matched to the U47's). The 6AU6 tubes in the two Sonys were replaced by two aged ones which were almost identical, and bridging resistors in the microphone power supplies checked; balanced lines checked for continuity; all heads were cleaned and demagnetized before each new reel of tape used. Seven years ago we walked in, put a microphone and stand somewhere in front of the musicians, pressed a button, and that was IT! Wonder whatever happened to those good old days?

Microphone suspension in the West High Auditorium for the two main concerts consisted of the two U47's, cardioid pattern, hung from the ceiling through the speaker louvres to a point in line-of-sight from the stage to the balcony (see Fig. 1 and 2). (The sound in the West High Auditorium, with the curtain open, goes toward the balcony, and the optimum listening position when the stage is baffled is about 7-feet above the balcony floor.) These mikes were then tied together with fishing line and rubber bands 26½-feet apart, and then both pulled back with more fishing line and rubber bands through a slot in the spotlight section until the microphones were hanging over the audience at a distance of 7-feet from the lip of the stage. Minor variations in location were made during rehearsals and concerts.

The two Sony C37A's were hung from the light bridge above the orchestra and

in front of the chorus, 22-feet apart, and set for a cardioid pattern for the orchestra and student concert, and then moved closer to the chorus and reset to omni for the final concert of the Haydn "Seasons." The reason for the cardioid pattern during the orchestra concert was to block the brasses on the close mikes but yet pick up more individuality in cellos, strings, flutes, oboes, and clarinets. (By the way, hanging microphones takes at least 4 hours, not to mention the time involved in constantly adjusting them).

Mr. Kirschbaum monitored and balanced microphone gain during rehearsals to achieve some separation of instruments from the Sonys and second, a "concert hall" effect from the U47's. Incidentally, due to their height, location, and sensitivity, the U 47's still did a fair job of picking up the strings. The left U47 was used to pick up solos. During concerts and rehearsals, with only

a pair of earphones to guide him backstage, Mr. Kirschbaum was able to bring out the individual voices of both orchestra and chorus with very light gain on the Sonys.

Only 15 seconds was needed to change reels during the "Seasons" concert and yet Mr. Shaw graciously asked if four minutes would suffice. The playback in the West High Auditorium during our working hours was very aptly taken over by the auditorium manager with one of his Berlant 505's, and he also loaned two of his Berlant 505's, Pilot and Citation stereo amplifiers, and individually hooked-up six loudspeakers for Mr. Ussachevski's tape-recorded solo with the Festival Orchestra in his own composition "Rhapsody Variations." This was a very effective work, and while Mr. Ussachevski cued in his taped solos and varied his assortment of speaker volumes, he had about five pieces of splicing tape on his respective fingers. It would indeed have been interesting to ascertain his splicing speed, however a break never occurred.

The nightly concerts in the Sidney Laurence Auditorium, which consisted of the two Jacob Niles children's and adult concerts, Willamette String Trio concerts, Westwood Wind Quintet, Master Vocal (Valente, Berberion, Wainner) vocal solos, the two Loraine Koranda Eskimo-Aleut-Indian-Music presentations, and poet Kenneth Rexroth, (missed this but the 10 hours sleep was delicious) required only a sharp cardioid (for standing waves) microphone, a mono recording, and a simple push of the little button, therefore this author took on this responsibility. Playbacks of some of these were taken care of in the West High Auditorium during the day by the auditorium manager.

After the Ball . . .

When the final curtain came down, it meant that the halfway mark was reached. The next two days were spent in taking down the microphones, packing the equipment, transporting it, and rechecking it all at home. The next two months were devoted to duplicating in-

(Continued on page 70)

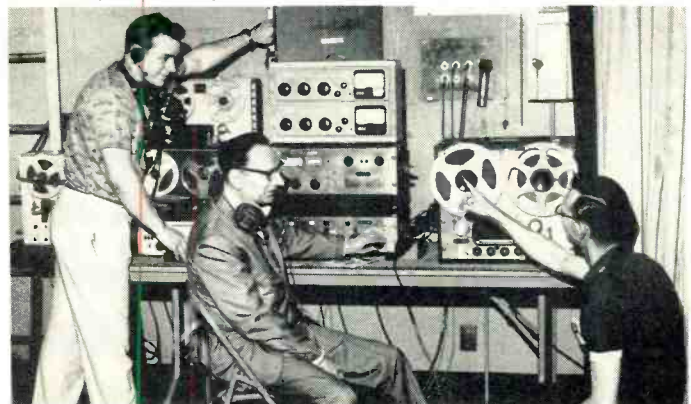


Fig. 3. Recording equipment and operators. On left, Ralph Daniels, auditorium and stage manager; center, Marvin Kirschbaum, mixer; right, Gil Daney, the recording engineer (and author).

A Transistor FM Squelch

K. E. SPRINGER*

With the addition of two transistors and a few other parts, a squelch can be added to tuners using the saturated plate-current pentode limiter.

MANY PRESENT-DAY FM TUNERS incorporate a variety of tuning aids. Included are such items as a/c, signal-strength indicator, detector null indicator, and squelch. The first three items are generally known to the audio-fan. The latter item, squelch, may not be as well known.

A squelch is a device that silences the tuner audio output in the absence of a signal. In particular, interchannel tuning noise is suppressed.

This noise is a result of amplitude sensitivity of FM detectors. Discriminators are quite susceptible in this respect. Ratio detectors are also susceptible but much less so. Classically the problem is solved by using amplitude limiters before the detector. Most common of these limiters is the saturated plate (current) pentode.

With the addition of two transistors and a few other parts, a squelch can be added quite easily to tuners using such limiters.

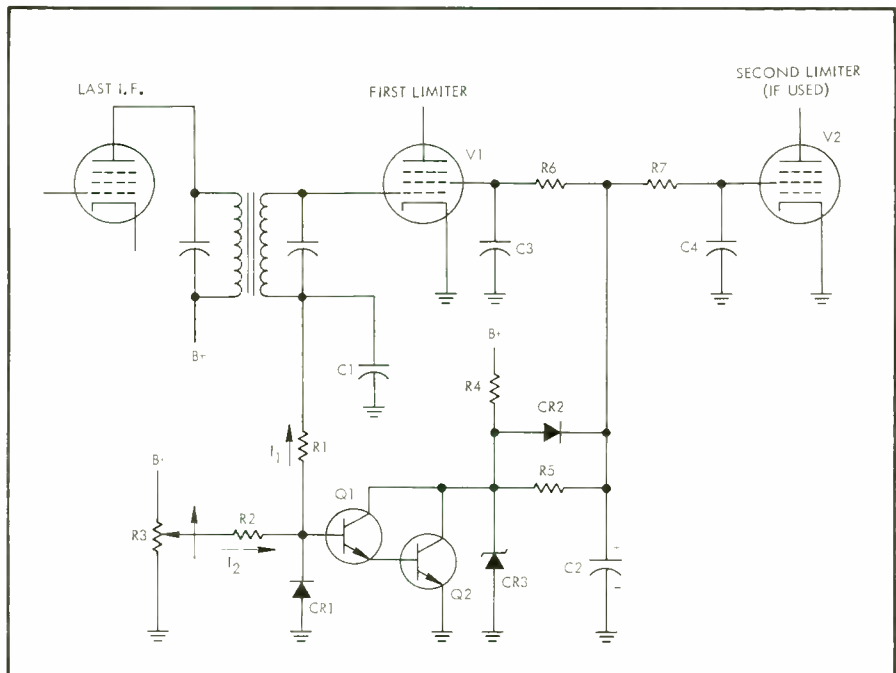


Fig. 2. Schematic of squelch circuit.

How It Works

The squelch operates from limiter grid return current. Diode detector action in the grid circuit causes this current. Pertinent circuit detail is shown in Fig. 1. With no signal input, the control grid-cathode diode rectifies the noise present.

* Aerospace Group, Hughes Aircraft Company, Culver City, California.

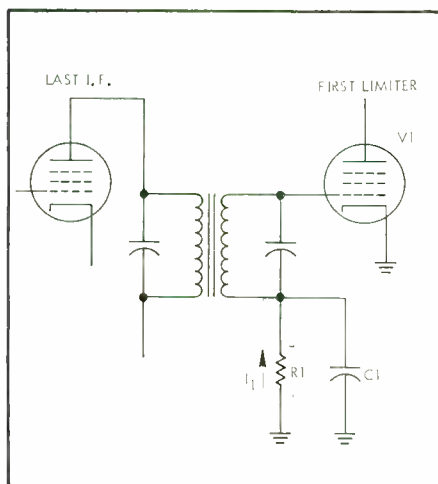


Fig. 1. Limiter-guide diode detector.

The result is a small voltage across the limiter grid resistor (detector load), R_1 . When signal is applied, it is also rectified, causing an increase in the negative voltage across, and an increase of the current through R_1 . The current is a direct function of the signal strength.

The squelch circuitry is shown in Fig. 2. In the absence of a signal the Darlington-connected transistors, Q_1 and Q_2 , are turned on by bias current, I_2 , from R_2 and R_3 . This causes the collector potential to be nearly zero. The screens of V_1 and V_2 follow because the collector is tied to the screen voltage source, the junction of R_4 and CR_1 . Reducing the screen-cathode potential cuts off the plate current as does increasing the negative control-grid bias. With the plate cut off, V_1 cannot amplify, resulting in squelch action.

When a signal is applied, I_1 increases above its initially small value, overcoming I_2 . Q_1 and Q_2 are cut off, allowing the screen voltage source to act normally. CR_1 provides a return path for $I_1 - I_2$ under this condition. If sufficient I_1 is not available, R_1 should be decreased. C_1 should be increased to maintain the original $R_1 C_1$ product.

Making It Do

Only one adjustment, R_3 , is required. Adjustment is made with no input signal. The control is rotated in a clockwise manner a few degrees past the point where the audio noise ceases. The arm of R_3 should be approximately centered. R_2 may have to be varied to achieve this. The squelch can be defeated by rotating R_3 completely counterclockwise or by grounding the base of Q_1 .

Design Thoughts

CR_3 serves two functions. First, it limits the collector voltage to approximately 33 volts. Second, it stabilizes the limiter screen voltage with varying signal.

The 33 volts for the screens is dictated by the transistor types used. Silicon units are suggested because of their inherently low I_{CEO} , resulting in more stable operation. The 2N697 is used because it is relatively cheap, approximately \$2.00 each in small quantities. If cost were no object, higher voltage units

(Continued on page 69)

An All-Electronic Method for Tuning Organs and Pianos

A. M. SEYBOLD*

Parts I and II of this series (February and May 1963) discussed errors caused by dial setting, synchronizing technique, and frequency drift. These errors were found to be small and not significant in the tuning of organs and pianos. This part continues the analysis of tuning accuracy, and discusses frequency standards and the use of the electronic tuner as a frequency-measuring instrument.

IF AN ORGAN is tuned to "A" at 441.466 cycles from a 60.2-cps line reference, but the setting is arbitrarily called 440.000 cycles, what kind of error is introduced? This question can be answered by the use of information shown in Fig. 1 and 2, which are correction curves for tuning-off-standard organs. The solid line in each figure is a normal calibration curve based on a 440.000-cps tone. The dotted and dashed lines represent the same oscillator calibrated at 430 and 450 cps, respectively, and at the same dial setting (52.0) for the "A" reference point. The solid line represents actual frequency data from 19.704 to 20.182 cps. The dotted and dashed lines represent only frequencies that are proportional to all tones of the scale referenced to 430 and 450 cps. The curves are practically identical for five dial divisions on either side of 52.0. The lines separate beyond five divisions, however, indicating that revised dial settings are necessary for C⁵, G⁵, D⁵, A⁴, C⁴, G⁴, and B⁴.

Figure 1 shows that the dial setting for B⁴ is 10.6 divisions when A = 440 cps. When A = 450 cps, however, the dial setting is 13.2 divisions. This difference is a result of the calibration curve not being a true straight line. In addition, there is a greater dispersion between the A and B tones when the reference "A" is 450 cps when it is 440-cps. After appropriate corrections, the setting for G⁴ is 16.6 instead of 14.3, and C⁵ is 20.2 instead of 18.3. When the reference is 430.000 cps, the dispersion between two tones is less than at 440 cps; as a result, the dial setting for B⁴ is 8.0 instead of 10.6, and the setting for G⁴ is 16.0 not 18.3.

Figures 1 and 2 include additional useful information. For example, in Fig. 2, the line between the points marked f_1 and P can be divided into ten equal

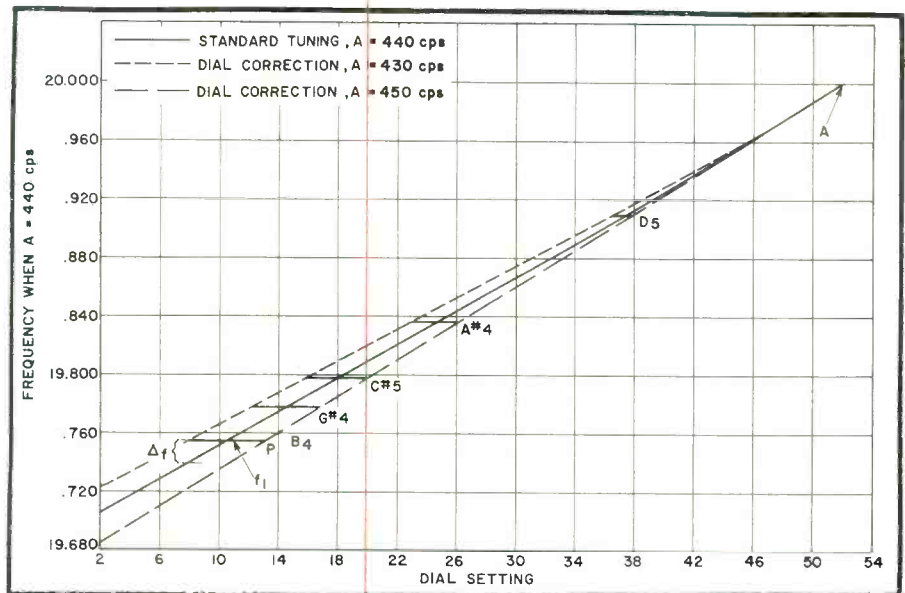
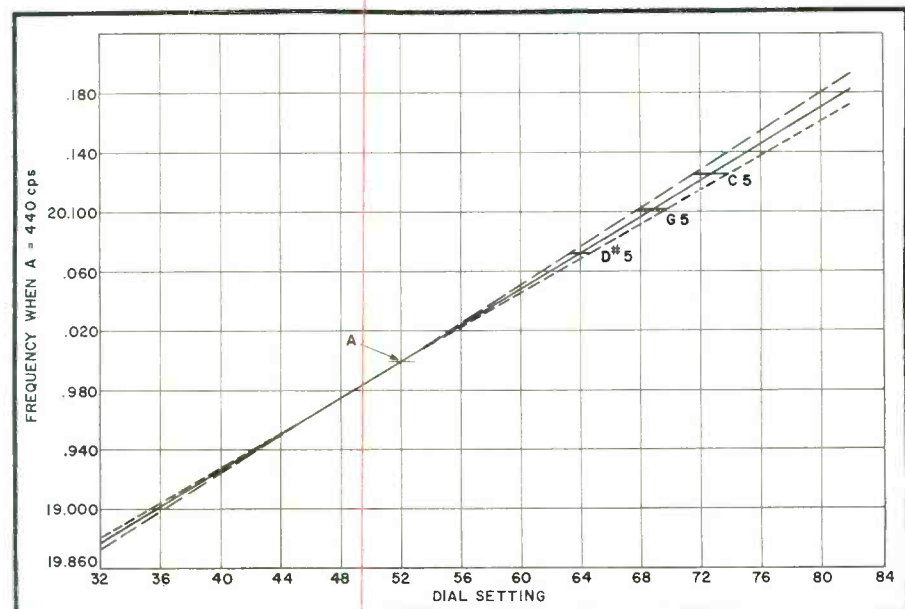


Fig. 1 (above) and 2 (below). Curves for tuning off-standard organs from a 440-cps tuner. The dotted line represents the dial settings needed to tune B⁴, G⁴, C⁵ and so on, in an organ that has a 430-cps "A." The dashed line gives corrections for an organ with "A" set at 450 cps. Intermediate values for dial setting referenced between 440 and 450 cps can be found along line f_1 -P.



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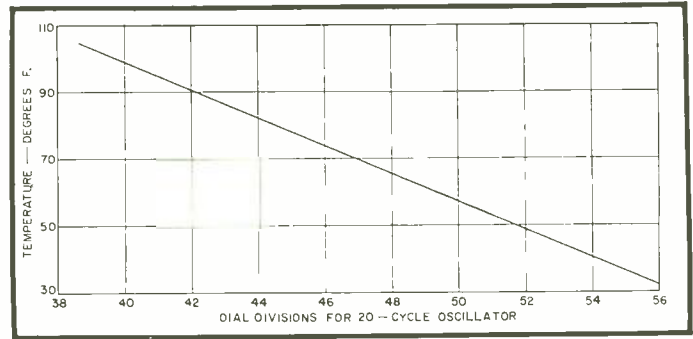
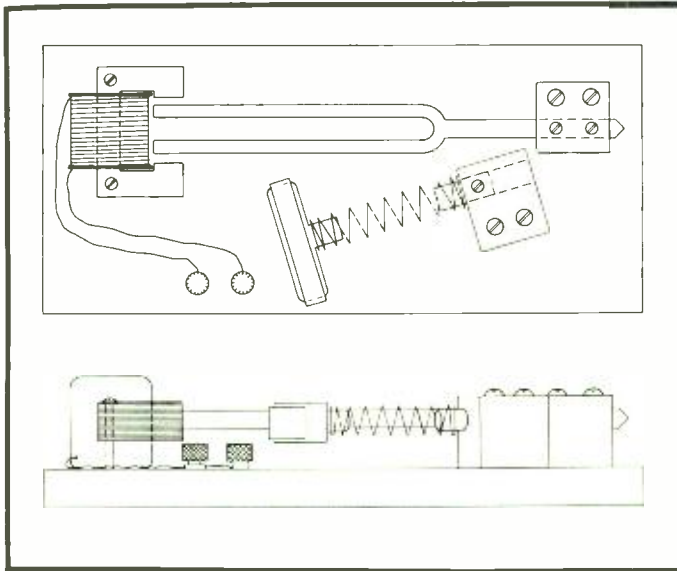


Fig. 3 (left). Two views of the tuning-fork generator. The base can be made of brass, bakelite, or other non-magnetic material. The pick-up coil is wound on a transformer core modified to provide a gap for the tuning fork. Fig. 4 (right). Calibration curve for the tuning fork. The reference point of 52.0 divisions on the tuner dial is set at 20,000 cps by the 600- and 440-cps tones from WWV. Dial readings on the fork are taken at five different temperatures from 32°F to 101°F; these points are then plotted to establish this curve.

parts. Each part is equivalent to a one-cycle differential at the reference frequency. For instance, at one-tenth of the distance from f_1 to P , a dial setting of 10.9 is indicated. This point represents the correct setting for B^4 when $A = 441.000$ cps. $G^{\#1}$ then requires 14.6, $C^{\#5}$ requires 18.5, and $A^{\#4}$ requires 25.0.

Without the correction at 441 cps, the error for B^4 can be calculated by means of the difference between 19.755 and 19.7565 cps. This 0.0015-cycle difference at 19.755 cps is equal to an error of 0.0076 per cent. Because this error is not significant, corrections in the range of standards from 439 to 441 cps are not absolutely necessary. Beyond 442 and 438 cps, however, corrections for B^4 , $C^{\#4}$, $C^{\#5}$ and $A^{\#4}$ are advantageous. For example, at 450 cps and 430 cps, the errors for B^4 are 0.076 per cent, and correction is obviously needed to maintain the high accuracy of the tuning system.

Figures 1 and 2 can be duplicated by calibrating a newly built tuner at 430, 440, and 450 cps, or they can be produced from a single 440-cps calibration curve by calculation. This calculation, however, is valid only if the components for R_1 through R_5 and C_1 through C_5 are similar to those shown in the diagram for this 20-cps oscillator (Fig. 1 of Part II). For part values within approximately ten percent of those shown, the correction curves can be constructed through the following points:

440-cps curve	Δf for 430 cps	Δf for 450 cps
B^4	+ 0.015	- 0.015
$A^{\#4}$	+ 0.010	- 0.010
$D^{\#5}$	+ 0.005	- 0.005
$F^{\#5}$	+ 0.002	- 0.002
$D^{\#5}$	- 0.003	+ 0.003
$C^{\#5}$	- 0.006	+ 0.006

Correction curves for off-standard tuning with the one-tube 27.5-cps tuner can be constructed through the following correction points:

440-cps curve	Δf for 430 cps	Δf for 450 cps
$F^{\#5}$	+ 0.007	- 0.007
B^4	+ 0.004	- 0.004
$E^{\#5}$	+ 0.002	- 0.002
$C^{\#5}$	- 0.002	+ 0.002
$G^{\#1}$	- 0.011	+ 0.011
$C^{\#5}$	- 0.013	+ 0.013

Correction curves for A's that are off-standard by more than plus or minus 10 cps are not necessary. Deviations up to 13 cps can be estimated by slight extensions of the f_1 - P lines. Any greater deviations are not needed because beyond +13 cps, A^b should be taken as the nearest tone to 440 cps and used for the "A" reference. Beyond -13 cps, $A^{\#}$ can be used as the new reference "A".

Although off-standard tuning may seldom be found necessary, this tuning method provides a useful corrective technique as well as an evaluation of a source of error that should not be overlooked. For instance, when a 60-cps frequency from the a.c. line is used for a reference, local power-company deviations of ± 0.1 cycle can result in a range for A^4 from 339.267 to 440.733 cps. As discussed above for off-standard tuning, the greatest error (0.005 per cent) occurs when B^4 is tuned from an "A" set at 440.737 cps. For B^4 , the occasional variation of the line frequency to 60.2 cps would produce an error of 0.01 per cent, a level which should be avoided.

In some parts of the country, deviations of greater than ± 0.2 cycle can be expected; therefore, although the a.c. line is a handy reference and is perhaps statistically adequate, further consideration should be given to secondary frequency standards.

Frequency Standards

In most parts of the world, signals can be heard from the U.S. National Bureau of Standards stations at Beltsville, Maryland, and Maui, Hawaii. Standard-frequency transmissions are broadcast almost continuously for 24 hours a day on 2.5, 5, 10, 15, 20, and 25 megacycles. Although a number of different audio signals are transmitted on the WWV and WWVH carriers, the 440- and 600-cps tones are the easiest to use for musical standards. During each of six 10-minute intervals starting on the hour, the 600-cps modulation tone is heard for the first four minutes. The 440-cps tone is transmitted from the fifth through the eighth minute.

Short-wave radios, amateur receivers, and many broadcast receivers with short-wave bands can be used to receive the transmissions. Although it is possible to use the 440-cps signal directly with an organ by setting the A with audible beat-notes, these beats are difficult to identify when there is fading of the radio signal. Accordingly, the audio signal from WWV should be fed into the vertical circuit of the oscilloscope, the tuner oscillator fed into the horizontal-syne circuit, and the dial set for 20,000-cps synchronization. Both the 600- and 440-cps signals can be used from WWV. With 600 cps, the multiplier is 30; with 440 cps, the number of sine waves in the pattern is 22.

After the tuner is set at 20,000 cps, the organ "A" should be immediately tuned to synchronize with the oscillator. This immediate transfer provides a very accurate method of setting A at 440,000 cps, and eliminates beat-note problems caused by fading. However, there are two disadvantages: the radio must be transported to the site of the organ, and good reception is necessary at the moment "A" is tuned.

For these reasons, a more convenient

TABLE I

FORK CALIBRATION—440 cps AT 52.0 OSC. DIAL							
°F	DIAL	440 cps	20 cps	°F	DIAL	440 cps	20 cps
65	48.1	439.46	19.976	78	45.0	439.03	19.956
66	47.9	439.42	19.974	79	44.8	439.01	19.955
67	47.6	439.38	19.972	80	44.5	438.97	19.953
68	47.4	439.36	19.971	81	44.3	438.94	19.952
69	47.2	439.34	19.970	82	44.1	438.92	19.951
70	46.9	439.30	19.968	83	43.8	438.38	19.949
71	46.7	439.27	19.967	84	43.6	438.86	19.948
72	46.4	439.23	19.965	85	43.3	438.81	19.946
73	46.2	439.19	19.963	86	43.1	438.79	19.945
74	45.9	439.14	19.961	87	42.9	438.75	19.943
75	45.7	439.12	19.960	88	42.6	438.70	19.941
76	45.5	439.10	19.959	89	42.4	438.68	19.940
77	45.2	439.06	19.957	0.24	DIAL DIV.	1° F	

secondary standard is required. Of all devices considered for use as a secondary standard, a tuning fork is most economical, most accurate, and most easily transported. Although this method cannot be expected to match WWV for frequency control with little effort a tuning fork can be calibrated against WWV to provide a good portable frequency reference. A steel fork is particularly useful because its magnetic properties can be utilized in conjunction with a pick-up coil to generate an audio signal for the oscilloscope. However, because the frequency at which a steel fork vibrates depends upon surrounding temperature, calibration against WWV must be conducted at several temperatures to establish the operating characteristics of the fork.

When used with an electronic tuner, a 440-cps fork does not have to be exactly 440 cps. If a calibrated fork happens to vibrate at 441.230 cps at room temperature, the tuner dial should be set at a division representing 20.056 cps ($441.230/22 = 20.056$). The range knob is then set so that the tuner-oscillator synchronizes with the fork. By resetting the dial to the 20.0-cps point (52.0 divisions), the oscillator is placed at exactly 20.000 cps. The organ "A" can then be tuned against this frequency to establish a 440,000-cps reference tone.

The first step in building the tuning-fork generator is to mount the fork on a brass block, as shown in Fig. 3. A pick-up coil is placed at the tine end of the fork, and a side-action spring used to provide mechanical tapping. The pick-up coil is built on an old transformer core by the following method: the core is disassembled and the laminations are cut to make a gap big enough for the fork and a clearance of about 1/16 inch. The core should then be reassembled to hold a winding of approximately 4000 turns of #34 enameled wire. The two leads of the coil connected to the binding posts are used for connection to the vertical-deflection terminals of the oscilloscope. The spring used to tap the fork is the type found on the fittings of ironing cords. A small hammer head cut from a phenolic panel strip is shaped to fit into the end of the spring. A wide rub-

ber band is wrapped around the hammer head to soften the blow.

When the spring is deflected by hand and released, a single blow activates the fork. By vibrating inside the poles of the coil, the steel fork generates a perfect sine wave and the signal appears at the terminals of the coil. This signal is generally about 1/2 volt. In four seconds it drops to about 0.1 volt, but for the next 10 to 15 seconds the decay is slow. During this period, measurements and synchronizing adjustments are made.

Calibration of the Tuning Fork

For the reasons mentioned previously, this tuning fork should be calibrated under as many varying temperature conditions as possible. The fork shown in Fig. 3 was calibrated at temperatures of 32°F, at 65°F, 71°F, 79°F, and 101°F. Before these measurements were taken, the fork was held at the required temperature for at least an hour, to be certain that temperature equilibrium had been reached. Although these extremes of temperature were not necessary, they did indicate that the frequency change of the fork was linear over a wide temperature range, thereby making straight-line estimations valid for a limited number of readings.

The fork, electronic tuner, and oscilloscope were taken to each location for the readings; however, the amateur radio receiver used to receive the signals from WWV, was left in its normal operating position. A 100-foot extension cord was

used to carry the audio signal from WWV to the oscilloscope.

Readings were taken by feeding the WWV audio signal to the vertical-deflection circuit of the scope. The tuner was connected to the horizontal-sync circuit, and synchronized at 20,000 cps to the WWV 440-cps tone. A line from the tuning-fork generator was then clipped to the vertical-deflection circuit of the scope, and a dial reading taken for the point at which the tuner-oscillator and tuning-fork signal were synchronized. The oscillator calibration curve was used to convert the dial reading to a frequency in the 20-cps region. The actual value was then multiplied by 22 to obtain the fork frequency.

The 600-cps WWV signal was used to take a second reading at each temperature. Because 600 cps also sets the tuner-oscillator at 20,000 cps, the repetitive operations used to determine the fork frequency at each temperature were identical.

Figure 4 shows the dial settings as a function of temperature, and is the basis for Table I. A copy of this table is attached to the bottom of the fork-assembly base for convenient reference. A small Fahrenheit thermometer is also kept with the fork so that the frequency of the fork can always be readily determined. The tuning fork eliminates the problems caused by a.c. line frequency variations or fading of WWV signals. In addition, the fork provides a degree
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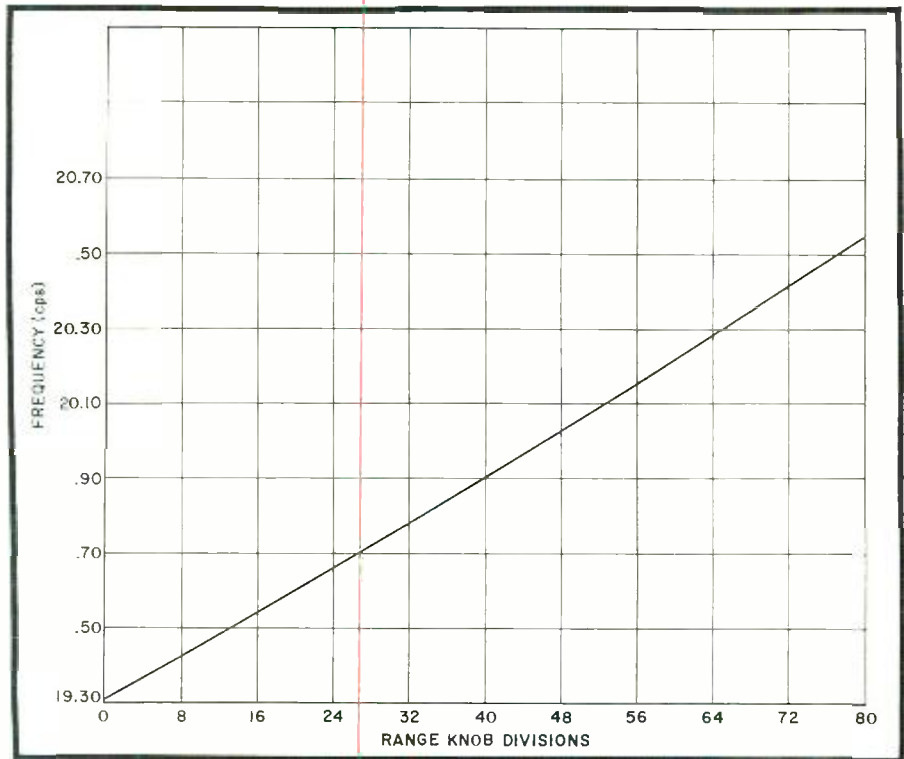


Fig. 5. A 440-cps organ tone is used to calibrate the range knob. In this operation, the vernier dial is varied until the oscillator runs at 20,000 cps for a range knob setting of 46.0. The rest of the points was found by timing with a clock.

Power

MANNIE HOROWITZ*

It's much easier to read on a meter than understand.

I. History

Men have fought wars for power. Men have killed for power. Men have cheated for power. Men have lied for power. Women have too.

II. Poetry

*Things are seldom what they seem,
Skim milk masquerades as cream;
Highlows pass as patent leathers;
Jackdaws strut in peacock's feathers.*

*Very true,
So they do.*

*Black sheep dwell in every fold;
All that glitters is not gold;
Storks turn out to be but logs;
Bulls are but inflated frogs.*

*So they be,
Frequentlee.*

From *HMS Pinafore*, W. S. Gilbert

III. Physics

The three words *force*, *energy*, *power* are all used more or less interchangeably (and properly so) in everyday speech. Moreover, many of the older scientific writers confuse them. But the student must remember that as used in physics these three terms have distinctly different meanings. *Power* means the rate at which work is done, that is, the amount of work done, or energy transferred, per unit time. . . . In paying the electric light bill as so much per Kw hour, one does not pay for electricity, but for *work done*, that is for *energy supplied*. . . .

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Work has been defined by the product of force \times distance, fd , so that the above definition for *power* may be expressed by the equation

$$P = fd/t = f(d/t) = fv$$

—Weld & Palmer "A Textbook of Modern Physics" P. Blakiston's Son & Co., Phila., 1925

IV. Electrical Power

I cannot think of one other factor characterizing a piece of audio equipment that has been presented more loosely and created more confusion than has been the case with power. The sentence "Bulls are but inflated frogs" of course refers to the power specification. The attempt to clear the air of the confusion in the 1925 textbook does not seem to have accomplished its purpose as yet. It still requires an engineer or physicist to mull through power specifications as currently presented and make sense from confused and confusing data.

Three categories of power ratings are frequently found in the various specification sheets. They are continuous sine wave power, peak power, and IHF music power. In each instance, the setup shown in *Fig. 1* can be used to make the required measurement.

The input to the amplifier is fed from a low distortion source of sinusoidal signal (or square wave or modulated signal where required). A resistive load, R , is substituted for the speaker system. The output voltage across the load is measured with an a.c. meter. The distortion level at which the measurement

is made is determined from the reading on the distortion meter and observed on the scope. The scope may be calibrated and used to measure voltages.

The power delivered by the amplifier to the resistive load can be calculated from the voltage, E , read on the a.c. VTVM. Assuming that the output meter reads rms voltages, the familiar equation E^2/R will be used. The procedure is self-evident when continuous sine wave power is to be determined.

For continuous sine wave power a sine-wave signal of 400 or 1000 cps is fed to the amplifier. When a predetermined distortion level is reached, the voltage across the load resistor is read on the a.c. voltmeter. The power at this level is determined by applying the equation E^2/R .

The peak power rating assumes that the peak of the sine wave power is capable of existing over a complete cycle, and not only at the peak or crest of the sinusoidal variation. This can frequently be realized, but not always. Manufacturers state their specifications as if their units do accomplish this. Mathematically, the peak power can then be stated as:

$$P_{peak} = E_{max}^2/R \quad Eq. (1)$$

where E_{max} is the crest or peak of the sinusoidal voltage excursions. Because

$$E_{rms} = \frac{E_{max}}{\sqrt{2}} \text{ and } E_{max} = \sqrt{2} E_{rms}$$

$$P_{peak} = \frac{(\sqrt{2} E_{rms})^2}{R} = \frac{2 (E_{rms})^2}{R} = 2 P_{av} \quad Eq. (2)$$

Equation (2) would tend to indicate that all requirements to determine peak power can be met by a simple measurement and calculation: Determine the continuous sine wave power from measurements and multiply that figure by 2. This is exactly the procedure followed by many specification writers.

An alternate method is to feed a 400 cps square wave through the amplifier. Increase the level until the square wave loses its characteristic shape. Because voltage is present at every instant during a square wave cycle, the amplifier will be delivering power to its maximum capabilities. Measure the voltage across the load resistor with a peak-to-peak reading voltmeter.

The square wave has the form shown in *Fig. 2*. The average voltage over the cycle is E_{max} , which is $E_{p-p}/2$. (E_{p-p} is

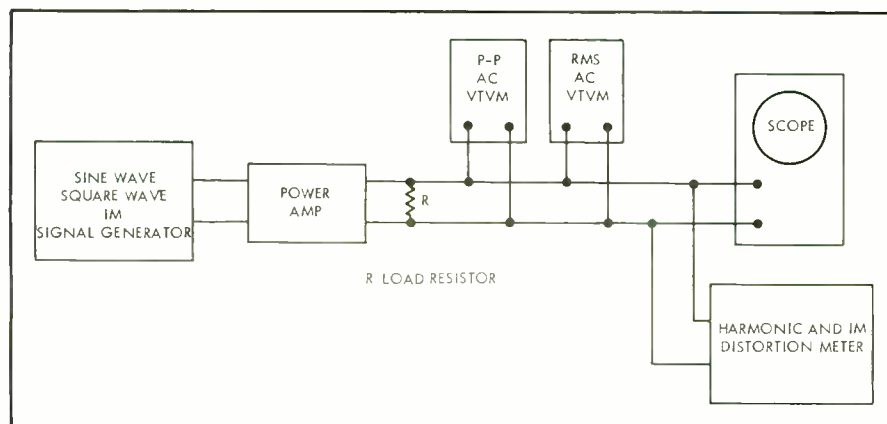


Fig. 1. Setup for measuring "power input."

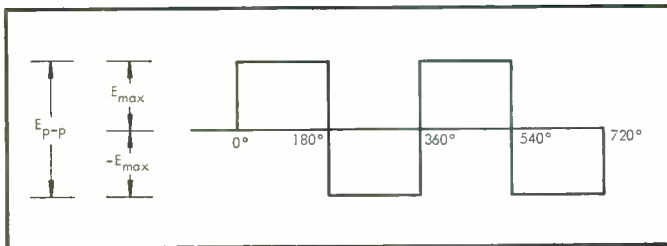


Fig. 2. Square wave.

the peak-to-peak voltage.) Then the maximum power across the load resistor is

$$P_{max} = \left(\frac{E_{p-p}}{2}\right)^2 \frac{1}{R} = \frac{(E_{p-p})^2}{4R} \quad Eq. (3)$$

The voltmeter and resistance readings are then substituted into Eq. (3). Results can differ considerably from those determined using Eq. (2). Which is valid? The answer will follow the description of the IHF power rating.

IHF music power is identical to sine-wave power except—except that it assumes that the power supply voltages do not change with signal level. In this measurement all d.c. supply voltages are maintained constant by using regulated external power supplies. Using these supply voltage conditions, the sine-wave power is measured at a predetermined distortion level, as described above. The IHF power is considerably above the figure determined in the original sine-wave power test. Many manufacturers use this rating. Is it valid?

Peak IHF music power is calculated from the IHF measurement by multiplying the IHF figure by two. This follows the logic of the peak continuous sine wave power just discussed Eq. (2).

In any of the above measurements, special precautions must be observed if a transistor power amplifier is under test.

While tubes can take voltage and power dissipation overload for a short period of time without being destroyed, this is not the case with transistors. An instantaneous overload can cause the complete destruction of the power transistor.

Indeed caution must be observed that the transistor is not overloaded at any time. Double check the transistor characteristics before applying a sine wave which will drive the amplifier to full output. Be even more cautious with the square-wave signal. In either case, do not feed the signal through the amplifier for a longer period of time than is absolutely required to make the test. The transistors may overheat and break down.

One further note: Do not use a lower value of impedance or resistance at the output of transistor amplifiers than is recommended by the manufacturer. At high output-signal conditions, the output transistors can be overloaded and destroyed.

Ideally, these precautions should not

be necessary. But at the present state of the art, they are vital.

V. Sense or Non-Sense

Each type of power rating has its own merits and drawbacks. The discussion below is opinion *only*, although it is based on fact. Opposing opinions can be stated with equal conviction and justice.

Continuous sine-wave power measurements make a lot of sense if the amplifier is to be used to amplify continuous sine-wave signals. But high-fidelity amplifiers are used for instantaneous sounds, such as music and speech.

The d.c. supply voltages in class-AB amplifiers change from the quiescent values when the amplifier is delivering its maximum continuous output power. However, with music or speech as signal sources, the voltages do not vary as much due to rapidly changing signal level. Power supply time-constants are too high to follow rapid signal variations. It then appears to be more realistic to use the IHF music rating rather than the continuous sine-wave output, as the standard. It should also be remembered that the "low loading" power amplifiers were based on this premise. No one, as yet, has actually disproved this.

However, music can incorporate sustained notes which will cause a variation in the supply voltages. In that case, the continuous sine-wave power is the most valid measurement.

In reality, both figures should be stated. An extreme difference between the two indicates a poor amplifier due to

inadequate power supply regulation. Low-frequency instability, such as motorboating, should be checked in any amplifier where the difference between these two figures seems excessive.

A big difference also indicates that the supply voltages will probably vary considerably with the various instantaneous music levels. At which supply voltages does one make the harmonic distortion test? In this instance, distorted data would appear to present a distorted view of an amplifier's capabilities.

As for peak power, the value is arrived at by multiplying the continuous or IHF power by two. This number looks impressive on specification sheets but has little significance unless the data supplied by the manufacturer are divided by a factor of two.

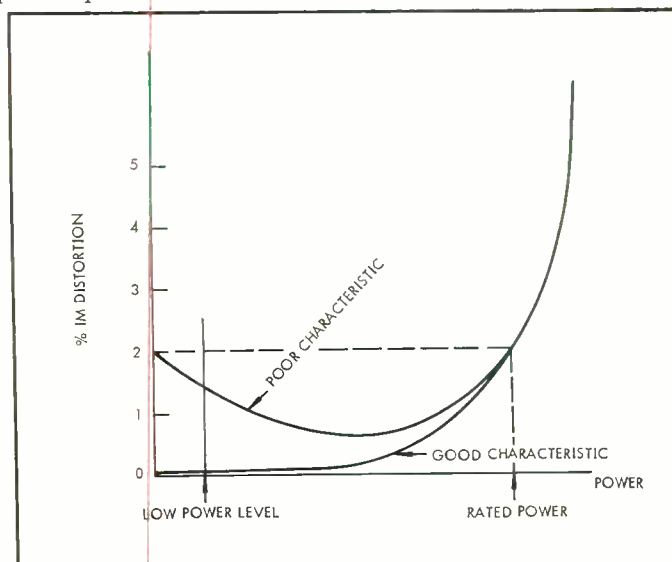
Measurements made using the square wave test described are more significant. It not only covers power supply weaknesses, but encompasses circuit and output transformer inadequacies (or capabilities) as well.

One other "fly in the ointment." The above measurements are usually made at 400 or 1000 cps. High-power output at low distortion levels is important at all segments of the audio spectrum between 50 and 10,000 cps. (Some experts would extend the importance even beyond these limits, however, speaker and ear limitations seem to make this range sufficient for most reproduction.) The measurements should be conducted to supply data at these frequencies. A curve should be plotted showing these data.

As a last factor, IM distortion must be considered. Should an amplifier be rated at a predetermined IM distortion level or at a predetermined harmonic distortion level? Probably both ratings are important. An IM distortion versus power curve should be supplied with each amplifier.

(Continued on page 73)

Fig. 3. Typical IM distortion curve.



A MAJOR BREAK-THROUGH IN SOUND PURITY

... BY **SHURE**

THE SOUND FROM THE NEW SHURE V-15 STEREO DYNETIC® CARTRIDGE WITH ITS REVOLUTIONARY BI-RADIAL ELLIPTICAL STYLUS HAS NEVER BEFORE BEEN HEARD OUTSIDE AUDIO LABORATORIES

by S. N. SHURE, President, Shure Brothers, Inc.

The sound from the new Shure V-15 Stereo Dynetic Cartridge is unique. The unit incorporates highly disciplined refinements in design and manufacture that were considered "beyond the state of the art" as recently as the late summer of 1963. The V-15 performance specifications and design considerations are heady stuff—even among engineers. They probably cannot be assimilated by anyone who is not a knowledgeable audiophile, yet the sound is such that the critical listener, with or without technical knowledge, can appreciate the significant nature of the V-15 music re-creation superiority. It is to be made in limited quantities, and because of the incredibly close tolerances and singularly rigid inspection techniques involved, it is not inexpensive. Perfection never is.

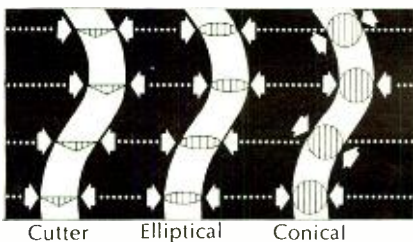
THE BI-RADIAL ELLIPTICAL STYLUS

The outstanding characteristic is that the V-15 Stylus has two different radii . . . hence the designation Bi-Radial. One is a broad frontal plane radius of 22.5 microns (.0009 inch); while the actual contact radii on each side of the stylus are an incredibly fine 5 microns (.0002 inch). It would be impossible to reduce the contact radius of a conventional spherical/conical stylus to this micro-miniature dimension without subjecting the entire stylus to "bottoming" in the record grooves.

The Shure Bi-Radial elliptical stylus, because of its larger frontal radius of 22.5 microns (.0009 inch), cannot bottom . . . and as you know, bottoming reproduces the crackling noise of the grit and static dust that in practice cannot be eliminated from the canyons of record grooves.

TRACING DISTORTION MINIMIZED

The prime objective in faithful sound re-creation is to have the playback stylus move in exactly the same way as the wedge-shaped cutting stylus moved when it produced the master record. This can't be accomplished with a spherical/conical stylus because the points of tangency (or points of contact between the record grooves and the stylus) are constantly changing. This effect manifests itself as tracing distortion (sometimes called "inner groove distortion"). Note in the illustration below how the points of tangency (arrows) of the Bi-Radial elliptical stylus remain relatively constant because of the very small 5 micron (.0002 inch) side contact radii:



The Shure Bi-Radial Stylus vastly reduces another problem in playback known as the "pinch effect." As experienced audiophiles know, the record grooves are wider wherever and whenever the flat, chisel-faced cutting stylus changes directions (which is 440 cycles per second at a pure middle "A" tone—up to 20,000 cycles per second in some of the high overtones). An ordinary spherical/conical stylus riding the upper portion of the groove walls tends to drop where the groove gets wider, and to rise as the groove narrows. Since stereo styli and cartridges have both vertical and horizontal functions, this unfortunate and unwanted up-and-down motion creates a second harmonic distortion. The new Shure Bi-Radial elliptical stylus, on the other hand, looks like this riding a record groove:



You'll note that even though it has a broad front face with a frontal plane radius of 22.5 microns (.0009 inch), and it measures 30 microns (.0012 inch) across at the point of contact with the groove, the small side or contact radii are only 5 microns (.0002 inch). This conforms to the configuration of the cutting stylus and hence is not as subject to the up-and-down vagaries of the so-called "pinch-effect".

SYMMETRY, TOLERANCES AND POSITIONING ARE ULTRA-CRITICAL

Frankly, a Bi-Radial elliptical stylus, however desirable, is almost impossibly difficult to make CORRECTLY. Diamond, as you know, is the hardest material . . . with a rating of 10 on the Mohs hardness scale. It's one thing to make a simple diamond cone, altogether another to make a perfectly symmetrical Bi-Radial stylus with sufficiently close tolerances, actually within one ten thousandth of an inch! Shure has developed unprecedented controls, inspections and manufacturing techniques to assure precise positioning, configuration, dimensions and tolerances of the diamond tip. It is a singular and exacting procedure . . . unique in the high fidelity cartridge industry. And, unless these inspection techniques and safeguards are used, an imperfectly formed elliptic configuration can result and literally do more

harm than good to both record and sound.

THE V-15 IS A 15° CARTRIDGE

The 15° effective tracking angle has recently been the subject of several Shure communications to the audiophile. It conforms to the effective record cutting angle of 15° proposed by the RIAA and EIA and now used by the major record producing companies and thereby minimizes tracking distortion.

The major features, then, of the V-15 are the Shure Bi-Radial Elliptical Stylus, the singular quality control techniques and standards devised to produce perfection of stylus symmetry, and the 15° tracking angle. They combine to reduce IM and harmonic distortion to a dramatic new low. In fact, the distortion (at normal record playing velocities) is lower than the inherent noise level of the finest test records and laboratory measurement instruments! In extensive listening tests, the V-15 proved most impressive in its "trackability." It consistently proved capable of tracking the most difficult, heavily modulated passages at a minimum force of $\frac{3}{4}$ grams (in the Shure-SME tone arm). The entire V-15 is hand-crafted and subject to quality control and inspection measures that result in space-age reliability. Precision machined aluminum and a special ultra-stable plastic stylus grip. Exact alignment is assured in every internal detail—and in mounting. Mu-metal hum shield surrounds the sensitive coils. Gold plated terminals. Individually packaged in walnut box. The V-15 is a patented moving-magnet device—a connoisseur's cartridge in every detail.

SPECIFICATIONS

The basic specifications are what you'd expect the premier Shure cartridge to reflect: 20 to 20,000 cps., 6 mv output. Over 25 db separation. 25×10^{-6} cm. per dyne compliance. $\frac{3}{4}$ gram tracking. 47,000 ohms impedance, 680 millihenries inductance per channel. 650 ohms resistance. Bi-Radial stylus: 22.5 microns (.0009 inch) frontal radius, 5 microns (.0002 inch) side contact radii, 30 microns (.0012 inch) wide between record contact points.

But most important, it re-creates music with a transcendent purity that results in a deeply rewarding experience for the critical ear.

Manufactured under U.S. Patents 3,055,988; 3,077,521 and 3,077,522. Other Patents Pending.

\$62.50 net

SHURE BROTHERS, INC.

222 Hartrey Avenue, Evanston, Illinois

Reducing Distortion in Stereo Phonograph Systems

J. G. WOODWARD*

Tracing distortion can be reduced by using a smaller radius on the pickup stylus, or distortion-cancellation techniques. The Dynamic Recording Correlator, a major part of "DYNAGROOVE," is an electronic means for cancelling tracing distortion. It points the way toward substantial improvement in stereodiscs.

In Two Parts—Part II

TWO MAJOR FORMS of distortion are inherent in the stylus-groove relationships in stereodisc systems: tracking-angle distortion and tracing distortion. The mechanism of tracking-angle distortion was discussed in Part I of this series, and techniques for reducing that form of distortion to very low values were described. We now turn our attention to tracing distortion and to techniques by which it may be reduced.

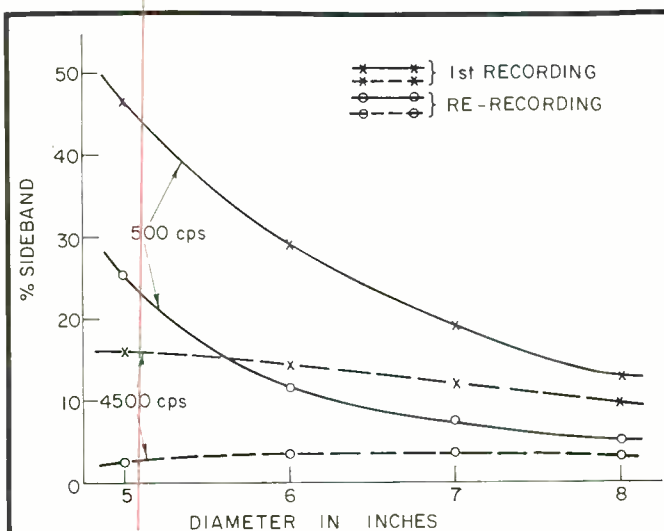
Tracing distortion occurs because the tip radius of the pickup stylus is comparable to the radius of curvature of the recorded groove modulation being traced by the stylus. Thus, tracing distortion is most severe for high-level, high-frequency signals recorded closest to the center of the record disk, although the occurrence of tracing distortion is not limited to these conditions. Modulations having curvatures comparable to the curvature of the pickup stylus can be recorded if the cutting edges of the recording stylus are sufficiently sharp, which is usually the case. In the case of monophonic, lateral-cut records the force causing the side-to-side displacements of the pickup stylus is applied alternately by the two opposite groove walls, and first one groove wall and then the other determines the path of the stylus. It has been known for many years that this push-pull action results in the elimination or drastic reduction of the odd-order components of tracing distortion. In the case of stereophonic records this push-pull action is not present for vertical and single-channel components of modulation, and tracing distortion becomes a basic limitation of the quality of sound reproduced from stereodiscs.

Methods of Reducing Tracing Distortion

Three methods of reducing tracing distortion, while maintaining the same re-

* RCA Laboratories, Princeton, New Jersey.

Fig. 1. Intermodulation sidebands measured in playback of a 2000 + 2500 cps signal in a first recording and in a re-recording of the signal reproduced from the first recording.



corded levels and wavelengths, are known. The first, and most obvious, method is that of simply reducing the dimensions of the playback stylus. This approach has been exploited with notable success, as evidenced by the change from the standard 3-mil tip radius used in 78-rpm playback to the 0.7-mil radius most commonly used in stereo pickups. The quality of reproduction from stereodiscs would be unacceptable if the smaller stylus were not used. Styli having tip radii of 0.5 mil, and more recently 0.3 mil, have been made available in efforts to achieve still further reductions in tracing distortion. These very small dimensions do, indeed, offer the possibilities of further reduction of distortion. However, there are practical considerations which set limits to the minimum tip radius which can be used at the present time. It is known that the forces existing between the pickup stylus and the groove walls are dangerously close to a magnitude sufficient to cause inelastic deformation and permanent damage to the groove walls of vinyl records. When the

tip radius is reduced, the stylus-groove wall forces are concentrated in a smaller area of contact, so the tracking force on the stylus must be reduced if damage to records is to be avoided. The reduction in tracking force then requires an increase in the compliance of the pickup in order to retain the tracking capability of the pickup for high-level, low-frequency modulation. For the same reason, the pickup must be mounted on an arm having very low friction in its pivot bearings. To avoid groove-wall damage due to the high acceleration forces occurring for high-frequency modulation, the stylus mass should be reduced when the tip radius is reduced—again because of the increased concentration of contact forces. When records which have collected an accumulation of dust and dirt are played, the low tracking forces required with smaller-tipped styli may not be sufficient to brush aside the dust particles in the groove. In some cases the stylus may be lifted completely out of contact with the groove by an accretion of dust particles caught under the stylus.



“...by combining this unit, Citation A, with a *solid state basic amplifier* of comparable quality, a sound path could be set up that approaches the classic goal of amplifier design—a straight wire with gain.”

—HIGH FIDELITY MAGAZINE

THE NEW CITATION B

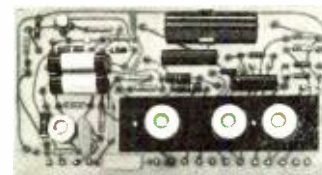
PROFESSIONAL 80 WATT SOLID STATE STEREO BASIC AMPLIFIER



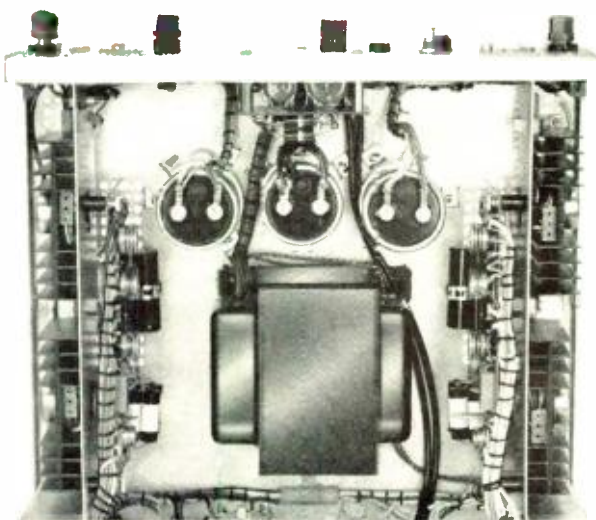
Handsome front panel: facilitates custom installation. Features include current-adjustment meter, on/off switch with pilot light and low-cut filter. Removable bottom panel conceals idling adjustment controls.



Computer-grade silicon output transistors: heavy-duty, solid state devices, virtually impervious to abuse. Will take .00% more power than their use in Citation B will ever demand.



Driver stage: Wideband silicon driver transistors are mounted on rugged, military-type epoxy glass board. Board pivots for easy accessibility or removal.



Top view of chassis: computer construction throughout. Five sub-assemblies assure easy accessibility and minimum operating temperature through efficient heat dissipation; laced military wiring harness couples each stage.



Electrolytic capacitors: engineered to computer-grade specifications for unlimited shelf life and consistent, long-term performance.



“Heat sink”: heavy-duty finned aluminum device which rapidly draws heat away from output transistors—insuring long life, fail-safe performance.

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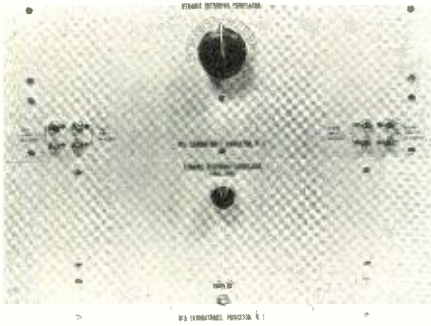


Fig. 2. Front view of the Dynamic Recording Correlator—a device for the electrical simulation of tracing distortion in a stereodisc system.

The factors just enumerated are not necessarily inherent shortcomings of small-tipped styli. However, they do show the problems of increased cost, more careful design and more stringent maintenance involved in pickups and in the other mechanical elements of the playback system when smaller stylus tips are used. Another limit on the minimum value of the tip radius is imposed by the radius of the bottom of the recorded groove. It is generally understood that the groove noise is lowest and that the stylus motion is best controlled when the stylus contacts the two groove walls rather than riding on the bottom of the groove. Industry standards in this country specify a maximum groove-bottom radius of 0.25 mil. Most commercial discs meet this requirement. However, an occasional record may be found to have a somewhat larger bottom radius. When the effect of elastic deformation of the groove walls under the stylus is added, and when the effects of vertical components of modulation are taken into account an effective bottom radius approaching or sometimes exceeding 0.3 mil may result.

The presence of vertical modulation in a stereo groove modulates the groove bottom radius as well as the included angle between the groove walls into which the stylus tip must fit. The seating of the tip is determined by the projection of the groove profile in a plane perpendicular to the groove bottom and containing the line between the stylus and the center of the record at each point along the groove. High-level vertical-modulation components may, therefore, instantaneously increase the effective radius of the groove by a significant amount. If, in such a case, the unmodulated bottom radius is already close to 0.3 mil, a 0.3-mil stylus may shift its points of contact alternately between the sidewalls and the bottom of the groove, thus introducing a different form of tracing distortion. It therefore appears that, with current recording practices, a 0.3-mil tip radius is approaching and perhaps occasionally exceeding the conditions for optimum tracing, and that

further reduction of tracing distortion through the use of still smaller pickup styli is not likely to be forthcoming.

The second method of reducing tracing distortion is by re-recording. This technique was used years ago to reduce distortion in vertical-cut transcription records.¹ It has been shown mathematically² that if the signal, including tracing distortion, resulting from playback of a recording is recorded on a second disc in reversed phase, the tracing distortion resulting from playback of the second disc exactly cancels the tracing distortion re-recorded from the first disc. An example of distortion reduction by this technique is shown in the laboratory measurements of Fig. 1. In this test two signals having equal velocity amplitudes at frequencies of 2000 cps and 2500 cps were recorded together in the left-hand channel and at various diameters on the dies. This record was played with a velocity-responsive pickup, and the reproduced signal was recorded, in reversed phase, on a second disc. Tracing errors result in the production of sum and difference tones of the 2000 cps and 2500 cps components. The magnitudes of the components occurring at 500, 2000, 2500 and 4500 cps were measured when playing both the first and the second recordings with a displacement-responsive pickup. The magnitudes of the sidebands at 500 and 4500 cps are expressed as percentages of the magnitude of the average of the 2000 and 2500 cps components in Fig. 1.

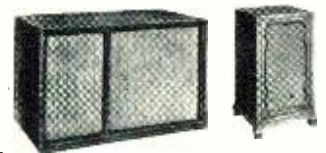
It is evident that the re-recording technique is effective in significantly reducing the magnitudes of the IM sidebands. Both tracking-angle distortion and tracing distortion are reduced by this technique. However, for the test signals used in this experiment tracing distortion predominates. The re-recording technique could probably be developed and incorporated in a practical system for use in commercial recording operations. For best results, such a system would require a pickup of higher quality and greater stability than any so far commercially available, and the maintenance requirements of the pickup and playback equipment would be quite demanding. Also, the re-recording process would require either a doubling of the time involved in cutting each master lacquer, or a doubling of recording facilities to allow the second recording to be made by one recorder at the same time that the first recording was being made and played

¹ J. A. Pierce and F. V. Hunt, "Distortion in Sound Reproduction from Phonograph Records," *Jour. Soc. Mot. Pict. Engrs.*, 31, 157 (1938).

² W. D. Lewis and F. V. Hunt, "Theory of Tracing Distortion in Sound Reproduction from Phonograph Records," *Jour. Acoust. Soc. Am.*, 12, 348 (1941).



W40—Ultra-compact (24" x 12" x 10") full-range system at a most attractive price. Two superior speakers: A newly developed 8½" low frequency driver with an extremely high flux density magnet—and Wharfedale's outstanding 5" tweeter—the same used in the larger W60 system. **Oiled or Polished Walnut or Mahogany, \$79.50. Utility model, \$69.50.**



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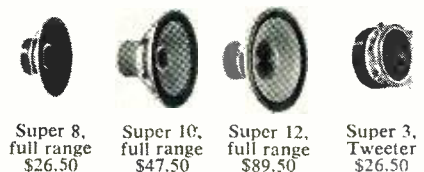


W70—A three-speaker system—handsome by itself, yet still sufficiently compact for shelf or wall integration. The beauty and excellent performance of this remarkable system make it equally impressive to experts and laymen alike. **Oiled or Polished Walnut or Mahogany, \$164.50. Utility model, \$146.50. Provincial in genuine Fruitwood, \$189.50.**



W90—A 6-speaker system with magnificent tone. The meticulously crafted cabinet is built to accommodate the speakers by range in isolated compartments; yet the size (32¼" x 27¾" x 13½") is sufficiently compact to fit into the modern living room. **Oiled or Polished Walnut, \$259.50. Utility model, \$244.50.**

COMPONENT SPEAKERS



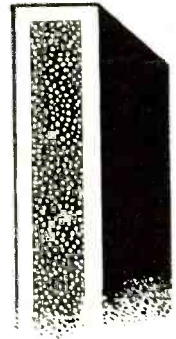
Super 8, full range \$26.50
 Super 10, full range \$47.50
 Super 12, full range \$89.50
 Super 3, Tweeter \$26.50



W12, Woofer \$52.50
 W15, Woofer \$89.50
 Crossovers available

invites you to look into an Achromatic speaker system

(For purposes of explanation, a model with a transparent cabinet but containing the actual speakers and other components of an Achromatic system has been constructed and photographed from three angles.)



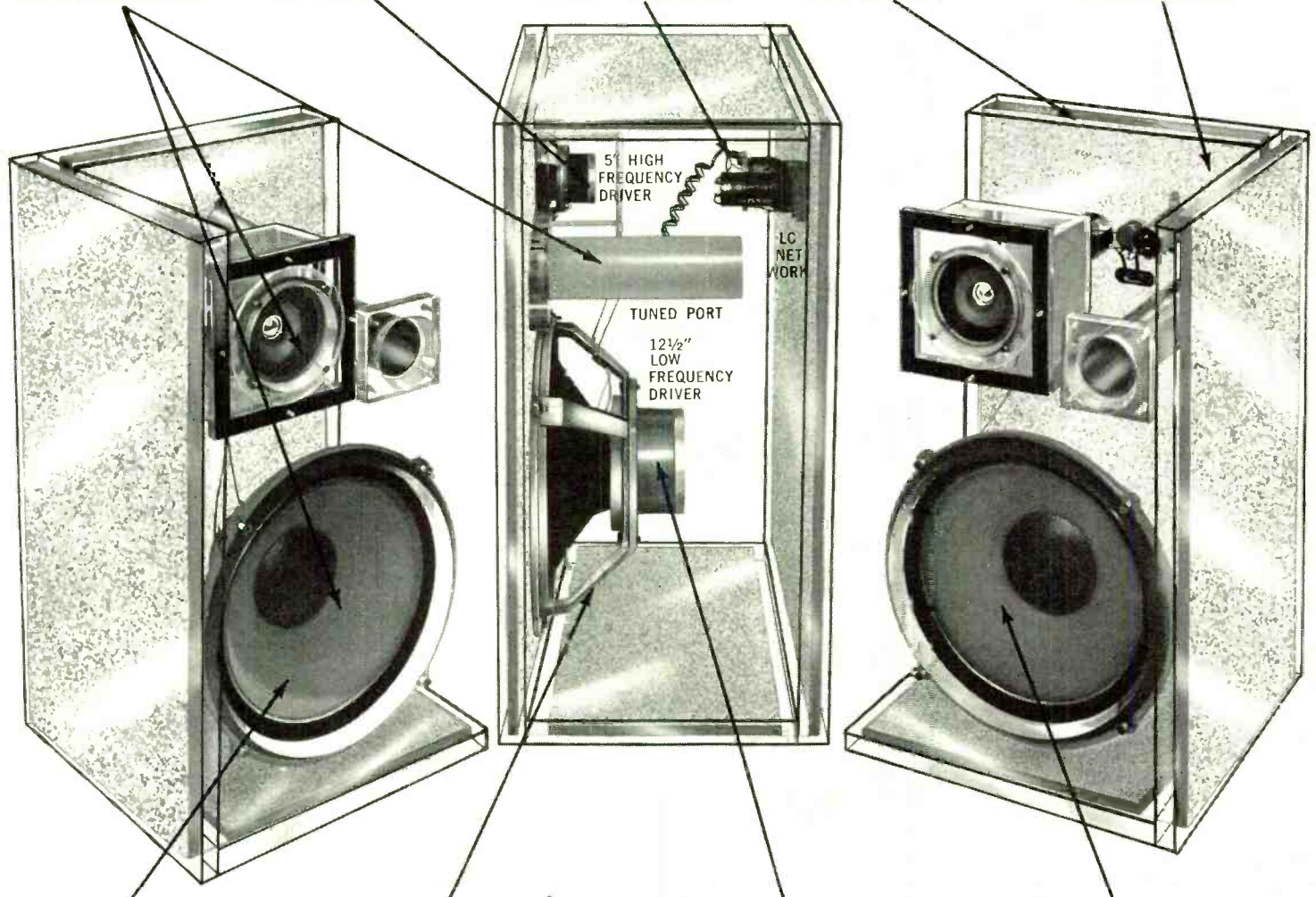
Component ratios; the aural parameters and phase relationships of the speakers; their precise physical locations, and methods of mounting are scientifically matched to the shape and cubic content of each cabinet. For example, here you see the two-speaker arrangement of the W60 speaker system, consisting of a 12½ inch low-frequency driver and a 5 inch high frequency cone type driver. In the W60 system specifically, this speaker combination, in its sophisticated tuned port cabinet, produces a distinctively natural, smooth sound.

The high frequency speaker is installed in a felt-sealed isolating compartment, which prevents mechanical crossover and interference between this and the other speaker(s). Even the access holes for wires are airtight, plugged with a dense sealing compound. Each speaker, therefore, operates to its best advantage in its own environment. A low mass aluminum voice coil is used here to give maximum high frequency response. Tuned ultrasonic tinning makes it possible to guarantee the coils for the entire life of the speaker!

A full LC network crosses over at the exact frequencies required for smooth, non-strident response from all the speakers, preserving the natural damping. Telephone grade electrolytic capacitors are used to assure long, trouble-free life. The coils are wound within our own plant to guarantee close tolerances. In the compact W40, W60, and W70, a precision-wound L pad gives 0-100% treble attenuation, and adjusts the highs to room acoustics (in the W90 6-speaker model, each range of speakers may be balanced and adjusted).

The operating function of the enclosure is to preserve the integrity of the speakers' performance through certain constructional features. Chief characteristic of the Achromatic construction is the sand-filled technique, which consists of packing white sand between layers of resinous-bound dense cabinet material, faced in turn, by pure wood veneers. This construction, used on certain prescribed baffle areas, creates an inert mass, incapable of resonating, no matter how deep or strong the bass backwave projected against it.

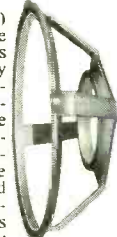
This exclusive technique, developed by G. A. Briggs, has proven so effective in preventing bass distortion that all Achromatic systems incorporate it despite the relative expense. In addition to the sand-filled panels, absorbent lining is used on some surfaces to eliminate undesirable reflections, and "hangover". *Optimum*, rather than maximum, absorption is considered important.



All of the speakers incorporate certain recent advancements. Because of this, it has been possible to achieve the clean, yet impressive sound which emanates from these compact cabinets. For example, the cone material is special... compounded of long fibred wool (traditional to the North of England home of these speakers) and soft pulp! Major purpose of this formulation is to provide natural, enduring resilience. The cone surround is an exclusive rolled-rim design, the latest and most effective form of the traditional Wharfedale soft suspension. One advantage is that this makes the cone capable of the long linear excursions required for true bass energy.



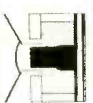
The chassis (baskets) of all speakers in the Achromatic systems are exceptionally heavy, and manufactured by casting. Purpose is to preserve absolute rigidity, maintaining the critical relationship between the moving voice coil and the fixed magnet. Ordinary stamped baskets often lose their rigidity when the speaker is mounted tightly against the unavoidably inexact wooden front baffle. Cast Wharfedale baskets hold their shape and are strong enough to permit the openings which are necessary to maintain correct air loading, essential for the full response of the speaker.



The magnets are truly impressive. Because of the advanced materials (Alcomax and Feroba) and the special design of the magnetic structure, each provides higher total flux in the gap field than has been true of magnets in any prior speakers. Tolerances are maintained permanently by filling spaces in the magnetic assembly with sulphur. These magnets enable Wharfedale systems to achieve maximum efficiency at low power, and to control high wattage amplifiers with equal ease.



Additional features have been engineered into certain of the speakers to preserve the clean sound of the Achromatic systems. For example, some have a special polystyrene diaphragm to eliminate any possibility of internal resonance. All have completely sealed magnet gaps which keep out foreign matter.



Above and beyond physical considerations, the concept behind the Achromatic speaker systems reflects extensive musical training and respect for musical values.

Wharfedale

Division of
British Industries Corp.,
Port Washington, N.Y.



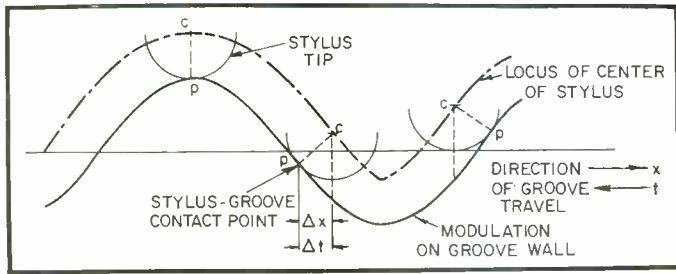


Fig. 3. Representation of a spherical stylus tracing a sinusoidal modulation in the plane of modulation of one of the 45/45 channels.

back on another recorder. In either case, the added cost and complication are not likely to be viewed with favor by the members of the recording industry who bear the responsibility for maintaining and operating the recording channels and for meeting tight production schedules—and this will be all the more true since an alternative is now available which provides the advantages of the re-recording method without its disadvantages.

In this third method of reducing tracing distortion, electrical simulation techniques are used to provide a signal equivalent to that produced in playback, including tracing distortion. This signal containing simulated tracing distortion may be recorded directly on the lacquer master, and playback of this master, or of pressings made from it, will result in signals in which tracing distortion is reduced to very low values.

Electrical simulation of tracing distortion has been incorporated in a practical device,³ called the Dynamic Recording Correlator, which can be simply inserted in the program bus feeding the master disc recorder in a stereo recording channel. Dynamic Recording Correlators have been in routine use at the recording studios of RCA Victor in the production of DYNAGROOVE records since early 1963, and were used experimentally at RCA Victor and at the RCA Laboratories for some time prior to that. A front view of the Correlator and its power supply is shown in Fig. 2. The remainder of this article will be devoted to a description of the operation of the Dynamic Recording Correlator and of its effectiveness in reducing tracing distortion.

It should be pointed out that the various methods described here for reducing tracing distortion do not remove certain overload limits inherent in disc recording systems. The recording amplifiers and the recorder, itself, have certain capabilities which cannot be exceeded without degradation of the quality of the signal. Moreover, the basic slope and curvature overload limits,⁴ based on stylus-groove

geometry, are still present. Once signals have been recorded at levels in excess of these overload limits, no amount of electronic or mechanical sophistication can correct for the resulting distortion. Such distortion can be avoided only by careful control of maximum levels during recording. Special "Recording Overload Indicators" have been developed at the RCA Laboratories which, when installed in place of conventional VU meters in a recording channel, can warn of occurring or impending overload conditions. However, these devices will not be discussed further here beyond mention-

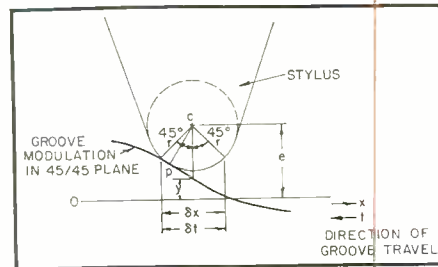


Fig. 4. Representation of a stylus in contact with a modulated groove in the plane of modulation of one of the 45/45 channels.

ing that they constitute another element in the RCA Victor DYNAGROOVE system.

The Mechanism of Tracing Distortion

In order to make the operation of the Dynamic Recording Correlator more understandable, we will first consider the basic mechanism involved in tracing distortion. Figure 3 is a diagram illustrating a pickup stylus tracing a sinusoidal modulation in one channel of a 45/45 stereo record. The solid line in Fig. 3 represents the modulation in the 45-deg. plane. In this plane the stylus tip is represented by a portion of a circle having its center at C. The stylus contacts the groove wall at P. As the stylus moves along the modulated groove, the contact point shifts back and forth under the center of the stylus. The resulting motion of the center of the stylus, which is proportional to the voltage developed by a displacement-responsive pickup, is a distorted sine wave as shown by the broken line in Fig. 3. Since the distortion is due to the periodic shifting back and forth of the stylus-groove contact point, we see that tracing distortion is a phase-modulation phenomenon rather than one arising from a simple, non-linear transfer characteristic.

The phase-modulation mechanism can also be shown^{3,4} to produce intermodulation products when two or more tones are recorded together. The intermodulation process may be conceived in a somewhat oversimplified way for the case of a low-frequency high-level signal re-

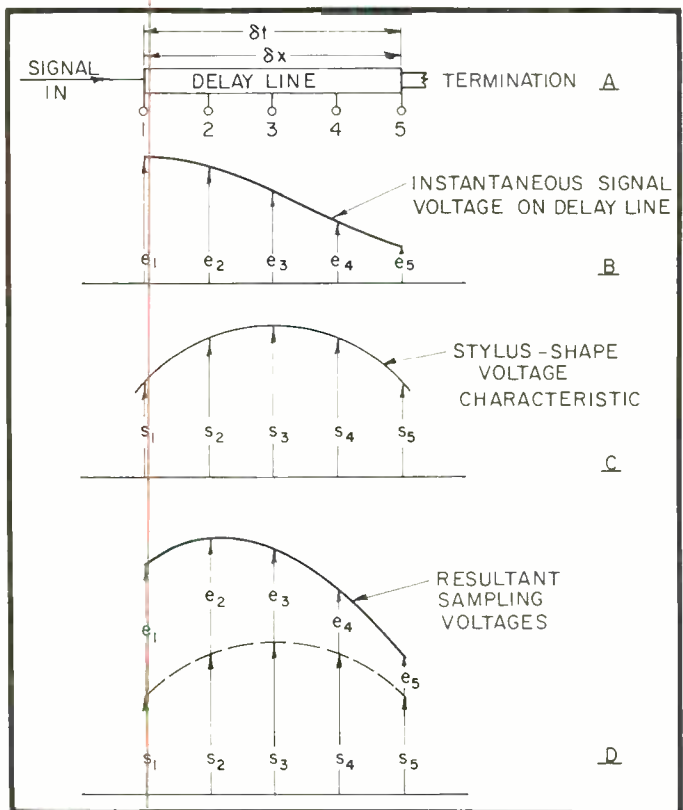


Fig. 5. Diagrammatic representation of the use of a tapped delay line for simulating tracing distortion.

³ E. C. Fox and J. G. Woodward, "Tracing Distortion—Its Cause and Correction in Stereodisk Recording Systems," *Jour. Audio Engrg. Soc.*, 11, 294 (October 1963).

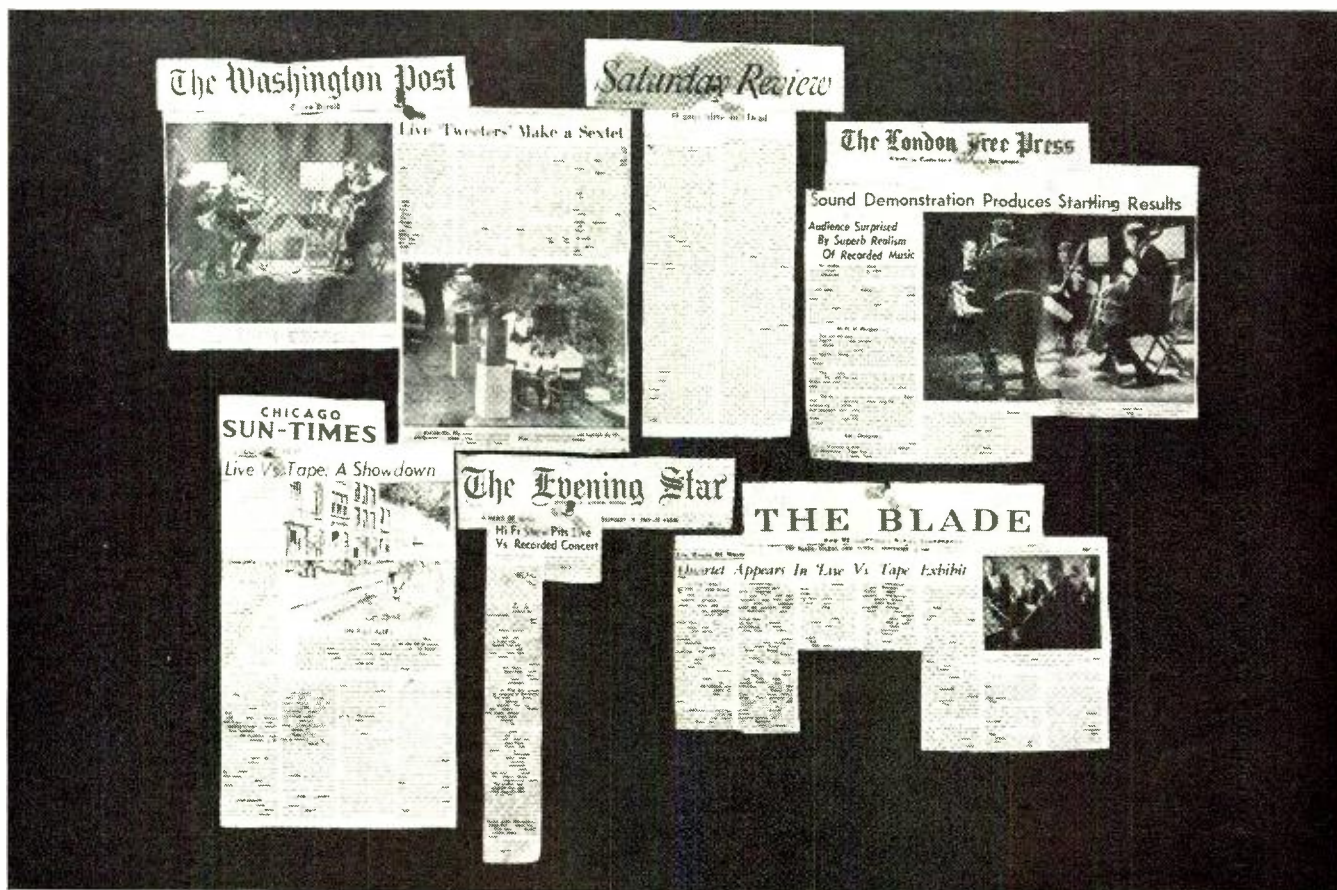
⁴ J. G. Woodward and E. C. Fox, "A Study of Program-Level Overloading in Phonograph Recording," *Jour. Audio Engrg. Soc.*, 11, 24 (January 1963).

*what hi-fi news
makes the
non-hi-fi
press?*

Events that loom large in the hi-fi world — a new design or a hi-fi show — rarely seem important to the world outside. But the **live vs. recorded** concerts staged by Acoustic Research (most of them in collaboration with Dynakit) have made news headlines in New York, Chicago, Toledo, Ontario, and Washington.

These concerts present a direct comparison between the live performance and its reproduction in stereo. At periodic intervals AR-3 loudspeakers, playing a previously recorded tape, take over from the musicians.

If the function of high fidelity equipment is to reproduce musical sound rather than to create its own kind of sound, such a comparison is the final test of loudspeaker quality. We know of nine reviewers* who reported that during these concerts they were unable to detect most of the switchovers from live to reproduced sound, from string quartet or pipe organ to AR speakers.



AR-3 speakers are \$203 to \$225, depending on finish. Other models are from \$89, all with a five-year guarantee whose coverage is complete, even to shipping charges. Literature, including a list of dealers in your area, is available on request.

*In addition to newspaper reviewers, critics in *Audio*, *The American Record Guide*, *High Fidelity*, and the *Saturday Review*.

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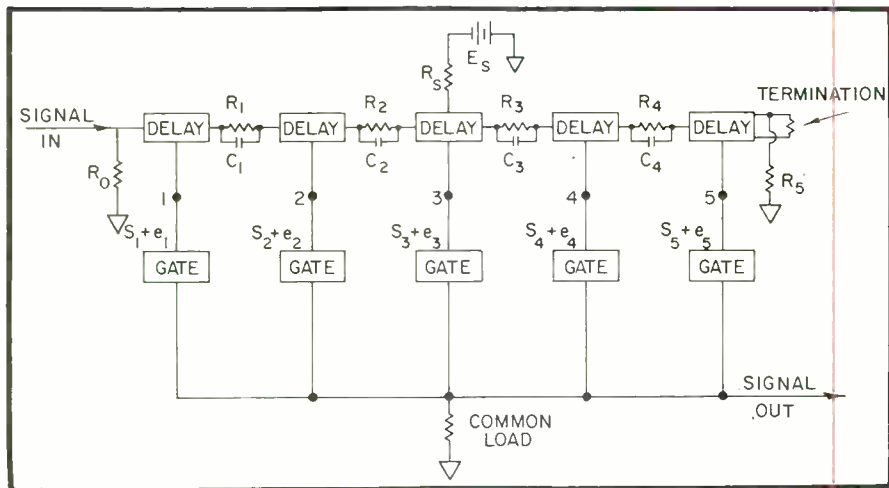


Fig. 6. Block diagram of a tracing-distortion simulator.

recorded together with a high-frequency low-level signal in one of the 45/45 channels. In playing back this signal the location of the stylus-groove contact at each instant will be primarily determined by the slope of the low-frequency modulation. As the contact point swings back and forth under the center of the stylus, it has an alternating component of velocity in the direction of groove travel which adds to or subtracts from the constant linear groove velocity at each instant. Therefore, the relative velocity between the groove and the contact point varies periodically at the low-frequency rate. This velocity modulation causes a frequency modulation of the high-frequency component, and the usual complement of FM sidebands on each side of the carrier frequency are generated.

When any pair of sinusoidal signals of frequencies f_1 and f_2 are recorded in one 45/45 channel and played back with a stylus tip radius, r , and a linear groove velocity, V_G , the approximate magnitude of each 1st-order sideband due to f_1 modulating f_2 is

$$\% \text{ 1st-order sideband} = (\pi r v_1 / V_G^2) (f_2 \times 100) \quad \text{Eq. (1a)}$$

for a displacement-responsive pickup, and

$$\% \text{ 1st-order sideband} = (\pi r v_1 / V_G^2) (f_2 \pm f_1) \times 100 \quad \text{Eq. (1b)}$$

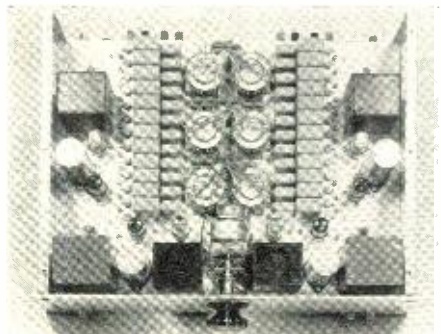


Fig. 7. Top view of the Dynamic Recording Correlator chassis.

for a velocity-responsive pickup. The peak velocity of f_1 is v_1 , and the magnitude of each sideband is given relative to the magnitude of f_2 in playback.

Similar expressions giving the approximate magnitude of the second harmonic of a single recorded tone of frequency, f , and peak recorded velocity, v , are

$$\% \text{ 2nd harmonic} = (\pi r v f / 2 V_G^2) \times 100 \quad \text{Eq. (2a)}$$

for a displacement-responsive pickup and

$$\% \text{ 2nd harmonic} = (\pi r v f / V_G^2) \times 100 \quad \text{Eq. (2b)}$$

for a velocity-responsive pickup. In analytical studies it is important to specify, as is done here, whether a displacement-responsive or a velocity-responsive pickup is used in a measurement or a calculation. In a conventional phonograph the reproduced output after the RIAA equalization corresponds to neither a displacement- or a velocity-responsive pickup, although it approximates the former more closely.

Electrical Stimulation

It was shown above that tracing distortion is a phase-modulation phenomenon. Electrical simulation of tracing distortion is accomplished by providing an equivalent phase modulation of a signal by means of a variable-length delay line. Certain factors entering into the design of the device will be set forth with reference to Fig. 4 which depicts a sectional view of a spherical stylus tip of radius, r , in contact with the modulation on a groove wall of a record. The view shown is in the plane of the modulation in one of the 45/45 channels. The horizontal axis represents an unmodulated groove. The stylus-groove contact point is shown at P . As the modulation changes with motion of the groove past the stylus the contact point will shift back and forth as described earlier.

However, the contact must always fall within the span

$$\delta x = 2r \sin 45^\circ = 1.414r$$

since the dimensions of the recording stylus restrict the slope of the recorded modulation to maximum and minimum values of $\pm 45^\circ$. The span, δx , corresponds to a time segment

$$\delta t = \frac{\delta x}{V_G} = \frac{1.414r}{V_G}$$

In the distortion-simulation device a signal voltage proportional to the modulation displacement is provided. This signal is then displayed and sampled over a segment of time, δt , determined by the stylus size and the groove velocity. A tapped delay line is used for this display and sampling process. If the total delay time of the line is δt , a segment of the signal of this duration will be present in the line at any given instant. This segment may be sampled at various points along the line as indicated in (A) and (B) of Fig. 5. For purposes of illustration, five equally-spaced sampling points are shown.

In this electrical analog of the playback process the shape of the pickup stylus tip is represented by a d.c. voltage adjusted to have different values at different positions along the delay line. Corresponding to the circular cross-section of the spherical stylus tip, in the

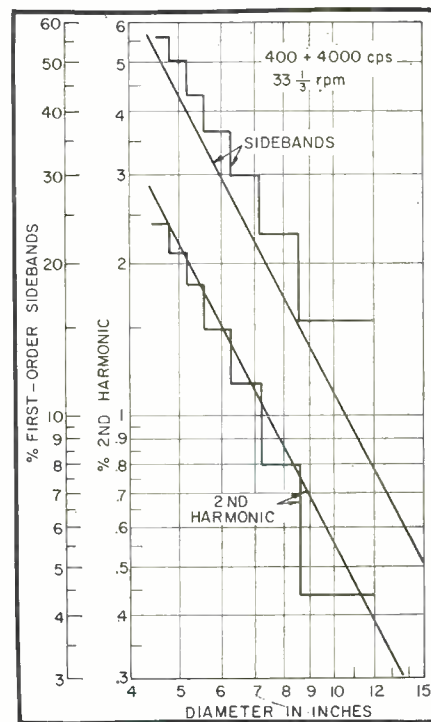


Fig. 8. Straight-line plots: Theoretical percentage 1st-order sideband and 2nd harmonic components of tracing distortion. Step-shaped plots: Electrically-simulated tracing distortion in the output of the Dynamic Recording Correlator for each of the 7 positions of the diameter switch.

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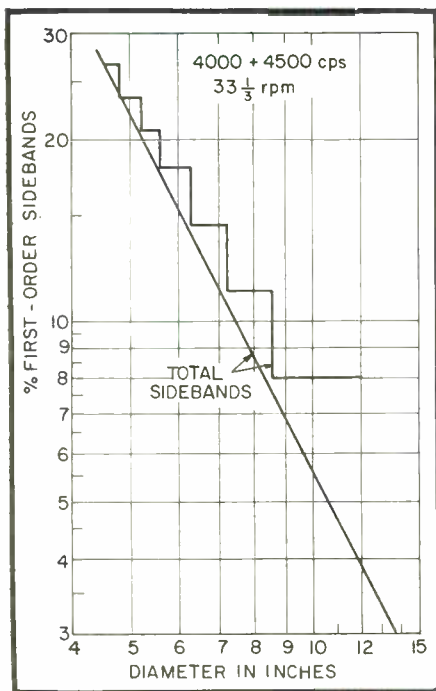


Fig. 9. **Straight-line plot:** Theoretical percentage 1st-order sideband components of tracing distortion. **Step-shaped plot:** Electrically simulated tracing distortion in output of the Dynamic Recording Correlator for each of the 7 positions of the diameter switch.

plane of modulation, the "stylus-shape voltage" is a circular voltage-vs-length characteristic along the length of the line. This is illustrated in (C) of Fig. 5. The instantaneous signal voltage at each sampling point is added to the stylus-shape voltage to give the resultant sampling voltages as shown in (D) of Fig. 5. Sampling-point 3 corresponds to a stylus-groove contact directly below the center of the stylus in actual playback. When tracing the modulation waveform depicted in (B) of Fig. 5, the contact will be to the left of the center of the stylus and at a position corresponding to sampling-point 2. The displacement of the center of the stylus and, hence, the instantaneous voltage generated by the pickup, will be proportional to $S_2 + e_2$. For other waveforms the stylus-groove contact will move to the other points on the stylus, and there will be a corresponding shift of the maximum value of $S_n + e_n$ to other sampling points in the electrical analog. In every case, however, the maximum value of $S_n + e_n$ occurring at any sampling point in the analog is proportional to the instantaneous value of the voltage at the terminals of a displacement-responsive pickup when reproducing the same modulation waveform. This relationship is only approximate since the analog, as described here, attempts to represent a continuous function by a finite number of sampling points. The approximation can be made as exact as one wishes by using a sufficiently large number of points.

A block diagram of the electrical analog of the playback process is shown in Fig. 6. Again, for purposes of illustration, five sampling points are used and the delay line is broken into five equal segments. A network including E_s , R_s , and R_o through R_5 provides the source and adjustment of the d.c. stylus-shape voltages at each sampling point. The capacitors, C_1 through C_5 , bypass the resistors for audio frequencies, so the delay line is not affected by the presence of the resistors between the segments of the line. Each sampling point is connected to a gating circuit, and all of the gates are connected to a common load. These are amplitude-selecting gates which are inter-connected in such a way that the only gate which is open is the one receiving the largest signal at that instant. This gate will pass this signal to the load, as being proportional to the output of a pickup. With continuously-varying waveforms there will be instants of transition when two gates receive the same value of sampling voltage and,

hence, will simultaneously pass equal voltages to their common load. The gate circuits have been so devised that if two gates are passing equal signals, each of the open gates loads the other open gate with an impedance equal to its internal impedance. Thus, the resulting voltage across the common load remains the same whether one or two gates are open to the same sampling voltage. This feature removes the possibility of the generation of transient pulses when the maximum value of $S_n + e_n$ moves from one sampling point to another as the signal moves down the delay line.

The Dynamic Recording Correlator

The Dynamic Recording Correlator (DRC) in which the foregoing principles have been incorporated, is shown in a front view in Fig. 2. The power supply is contained in the lower rack-mounting chassis, while the delay lines, gates, and necessary accessory amplifiers and equalization networks are contained in the upper chassis. A top view of the upper chassis is shown in Fig. 7. This chassis

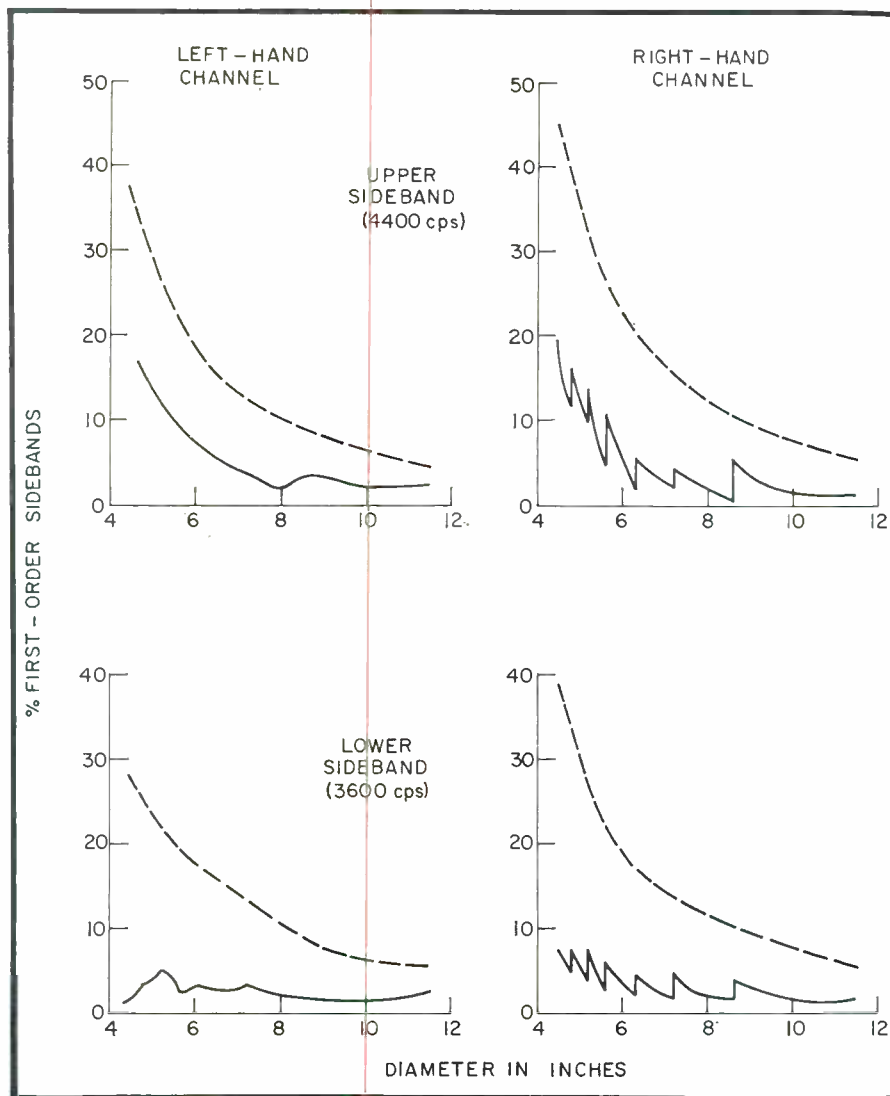
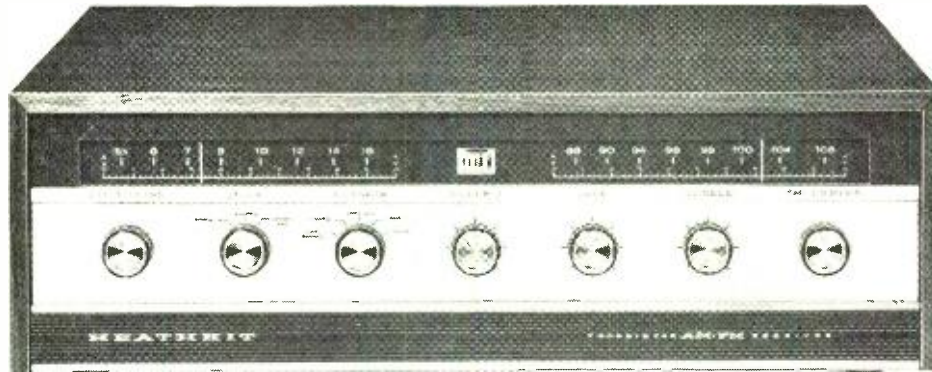


Fig. 10. Playback measurements of 1st-order sidebands of a 400 + 4000 cps signal recorded without (dashed curves) and with (solid curves) the Dynamic Recording Correlator in the system.

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kc. less than 1% @ 20 kc. **Intermodulation distortion:** (at rated output) Less than 1%, 60 & 1,000 cps. signal mixed 4:1. **Hum & noise:** Mag. phono, 50 db below rated output. Aux. inputs, 15 db below rated output. **Channel separation:** 40 db. **Input sensitivity:** Mag. phono, 6 MV. **Outputs:** 4, 8, & 16 ohm and low impedance tape recorder outputs. **Controls:** 5-position Selector, 3 position Mode, Dual Tandem Volume, Bass & Treble Controls; Balance Control; Phase Switch; Input Level Controls; Push-Pull ON/OFF Switch. **FM: Tuning range:** 88 mc to 108 mc, **IF frequency:** 10.7 mc. **Frequency response:** ±3 db, 20 to 15,000 cps. **Capture ratio:** 10 db. **Antenna:** 300 ohm balanced (internal for local reception). **Quieting sensitivity:** 3% uv for 30 db of quieting. **Image rejection:** 30 db, **IF rejection:** 70 db. **Harmonic distortion:** Less than 1%. **STEREO MULTIPLEX:** **Channel separation:** (SCA Filter Off) 30 db, 50 to 2,000 cps. **19 KC & 38 KC suppression:** 45 db down. **SCA rejection:** 35 db down from rated output. **AM: Tuning range:** 535 to 1620 kc. **IF frequency:** 455 kc. **Sensitivity:** 30 uv @ 600 kc; 9 uv @ 1000 kc. **Image rejection:** 40 db. **IF rejection:** 55 db @ 1000 cps. **Harmonic distortion:** Less than 2% with 1000 uv input, 400 cps with 30% modulation. **Hum and noise:** 40 db. **Overall dimensions:** 17" L x 5 1/2" H x 14 3/4" D.

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contains identical delay lines, gates, and so on for each of the two stereo channels. The DRC is a unity-gain device operating from and into a 600-ohm program bus, and is inserted in the recording system immediately preceding the power amplifiers driving the recorder.

It was noted above that the total delay time required in the delay line is dependent on the linear groove speed and on the tip radius of the playback stylus. As presently used, the stylus-shape voltage is adjusted to correspond to playback with a 0.7-mil stylus tip radius, which is the size most commonly used in stereo pickups. Since the groove velocity changes with the distance of the record groove from the center of the record, the total delay time of the delay lines in the DRC must be adjusted as a function of the recording diameter. The values of delay time, δt , for diameters of 11.5-in. and 4.5-in. are 0.49×10^{-4} sec. and 1.26×10^{-1} sec., respectively. The DRC is provided with seven different values of delay time which are selected by a stepping switch that closes a succession of multi-pole relays. The stepping switch may be operated either manually or automatically by means of contacts mounted on the carriage of the recording lathe. The seven delay times were chosen to yield simulation of the playback process close to theoretical values for the following ranges of diameters: 11.5–8.6 in., 8.6–7.2 in., 7.2–6.3 in., 6.3–5.6 in., 5.6–5.2 in., 5.2–4.8 in., 4.8–4.5 in.

A number of tests were conducted to ascertain the degree to which the DRC actually simulates tracing distortion. Figure 8 shows results of one such test made with a 400 + 4000 cps signal having a 4:1 velocity ratio and a peak velocity in one 45/45 channel of 6.22 cm/sec. The straight line plots show the values calculated from tracing distortion theory. Eq. (1) and (2), for the percentage of 2nd harmonic of 400 cps and for the sum of the magnitudes of the sidebands at 3600 cps and 4400 cps expressed as a percentage of the magnitude of the 4000-cps carrier. The step-shaped plots are the corresponding 2nd harmonic and sideband percentages measured in the output of the DRC for each of the seven positions of the diameter switch. Similar results are shown in Fig. 9 for tests made with a 4000 + 4500 cps signal in which the two components had equal displacements. The amplitudes of the sidebands at 500 cps and 8500 cps on a displacement basis were added and divided by the amplitude of one of the original components to give the sum of the percentage of 1st-order sidebands, as shown.

Figures 8 and 9 show that the DRC gives a close, though not exact simulation of theoretical tracing distortion. The measurements shown in Figs. 8 and 9 were made with an early, laboratory

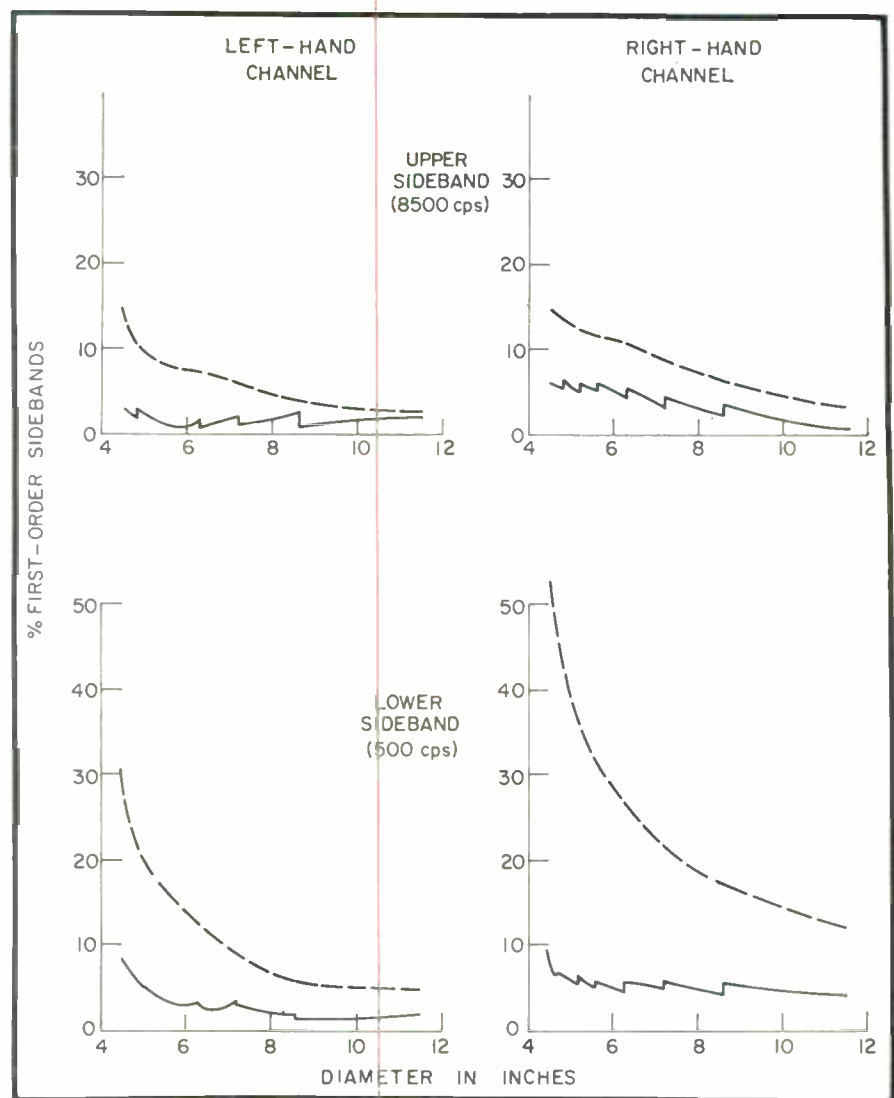


Fig. 11. Playback measurements of 1st-order sidebands of a 4000 + 4500 cps signal recorded without (dashed curves) and with (solid curves) the Dynamic Recording Correlator in the system.

model of the DRC. It was subsequently found that stray capacitance in the delay line was causing a longer delay time than was intended. When the effects of stray capacitance were removed in later models, the step-shaped plots such as are shown here were almost symmetrical about the theoretical plots, indicating a still closer agreement between theory and actual performance. In principle the theoretical distortion could be simulated as exactly as desired by a hyper-careful selection of circuit components and by use of a delay line of many sections. The 12-section line and the component tolerances used represent the point at which further increases in complexity and cost would result in negligible improvement in performance.

Record-Playback Tests

In evaluating the effectiveness of the Dynamic Recording Correlator in reducing tracing distortion many playback measurements were made of records cut

while using the DRC in the recording channel. Test signals used included sine waves, two-component IM test signals of various frequencies, bands of noise, and music. The DRC was found to be effective for every type of test signal which was tried. The results of two tests are presented here. The results shown in Fig. 10 are for 400 + 4000 cps in a 4:1 velocity ratio recorded as vertical modulation with a peak vertical velocity of 8.8 cm/sec., and having a vertical recorded angle of about 15 degrees. In playback the vertical tracking angle of the pickup was adjusted to minimize the tracking-angle distortion, as discussed in Part I. In the playback measurements plotted in Fig. 10, the curves show the magnitudes of the upper and lower tracing-distortion sidebands as a percentage of the 4000-cps carrier magnitude, plotted individually and for each stereo channel. The dashed curves show the results when the DRC was not used. The solid curves are the results when the DRC was used. The points at which the diam-



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eter switch position was advanced are evident in most instances. The data presented in Fig. 10 were measured using a velocity-responsive pickup. The reader may note that the per cent sum of sidebands obtained by adding the upper and lower sidebands without the DRC in Fig. 10 is the same as the value at the minimum of the sum of sidebands curve in Fig. 8 of Part I.

Comparable results obtained in playback of a 4000 + 4500 cps test signal are presented in Fig. 11. The two components of the test signal were recorded as vertical modulation with each component having a peak vertical displacement of 3.5×10^{-5} inch. The magnitudes of the sidebands at 500 cps and 8500 cps were measured and are plotted individually as percentages of the magnitude of one of the original components. The data are presented on the basis of measurement with a displacement-responsive pickup.

The data in Fig. 10 and 11, as well as many other measurements not presented here, all show that a noteworthy reduction in distortion is achieved through use of the Dynamic Recording Correlator. All of the various distortion products may now be kept to low values even for high-level signals at the innermost portion of the recorded area on a record. Tests have shown that even under curvature-overload conditions—i.e., when the minimum radius of curvature of the recorded modulation is less than the tip radius of the playback stylus—the DRC still functions. This is not to say that the DRC removes distortion due to curvature overloading when it occurs, but it does not introduce additional distortion or produce transients corresponding to those arising in the output of a pickup playing back a signal under such conditions. This, it may be noted, is another shortcoming of the re-recording technique.

Effect of Stylus-Tip Radius

It was mentioned above that the stylus-shape voltage used in the DRC was adjusted to correspond to a pickup stylus-tip radius of 0.7 mil. All of the playback measurements reported here were made with this tip radius, for which the tracing-distortion cancellation is optimized. The question arises as to the effectiveness of the DRC when some other tip radius is used in playback. Clearly, if a DRC-recorded stereodisc were played back with an infinitesimally-small stylus tip, all of the simulated tracing distortion introduced by the DRC would be reproduced as un-cancelled distortion. The smallest tip radius now available in pickups is 0.3 mil. Theoretical considerations, together with measured results for a 0.7-mil radius as shown above, lead to the expectation that use of the DRC adjusted for a 0.7-mil stylus should still

give a small reduction in tracing distortion when a 0.3-mil radius is used in playback. Actual measurements made using a 0.3-mil stylus to play back the 400 + 4000 cps record of Fig. 10 showed a considerably greater reduction of distortion than was expected. The reduction observed in the case of a 0.5-mil stylus was almost as great as that for a 0.7-mil stylus. If, at some future time, some value of tip radius other than 0.7 mil is adopted as a standard it will be a simple matter to re-adjust the stylus-shape voltages of the DRC to conform to that new standard. Present use of the DRC optimized for a 0.7-mil stylus will improve the quality of playback with other practical sizes of styli. However, optimum results will be achieved with 0.7-mil styli.

Discussion

Let us now review briefly the factors involved in reducing the distortion in the sound from stereo phonograph systems to the very low values reported here. In Part I the problems associated with the vertical-tracking angle were considered. The discrepancy between the recorder design angle and the vertical recorded angle was shown to be due to bending of the recording stylus and, to a lesser degree, the lacquer springback in the master. Simple corrective techniques for these factors were described by means of which it is now possible to provide almost any reasonable value of vertical recorded angle, and to adhere to a 15-deg. standard angle if desired. Practically, tracking-angle distortion can be eliminated as a limiting factor in the quality of reproduction only by adherence to the same standard vertical angle by both pickup manufacturers and by the record industry.

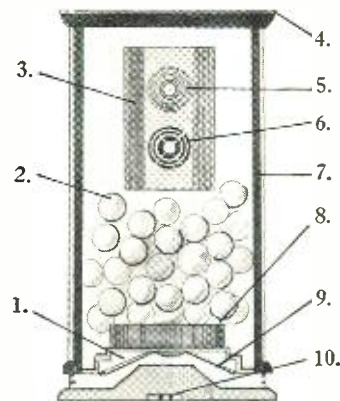
When tracking-angle distortion has been removed we are left with tracing distortion as the limiting factor. Tracing distortion can be reduced by using pickup styli having smaller tip radii, by using cancellation techniques, or both. The use of smaller styli places an inevitable burden of increased cost and maintenance problems on the ultimate user. The use of cancellation techniques, either by re-recording or by electrical simulation of tracing distortion, places the burden on the record industry. In view of the excellent results achievable with the Dynamic Recording Correlator there seems to be little reason for making the recording engineer's life unnecessarily complicated with re-recording operations. As more experience is gained and as manufacturing processes and consumer-type equipment are further improved, we may find that smaller styli and DRC techniques used together will prove to be the

(Continued on page 77)

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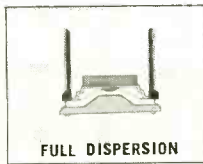


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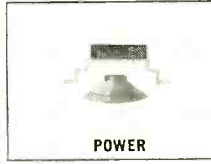
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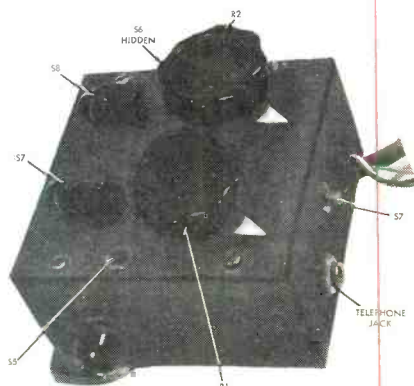


Fig. 1. Control box.

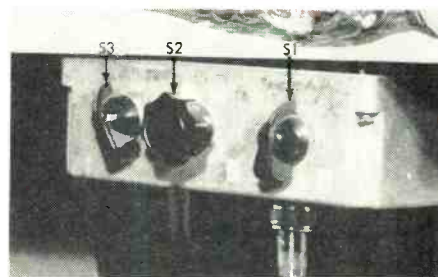


Fig. 2. Input selector switches.

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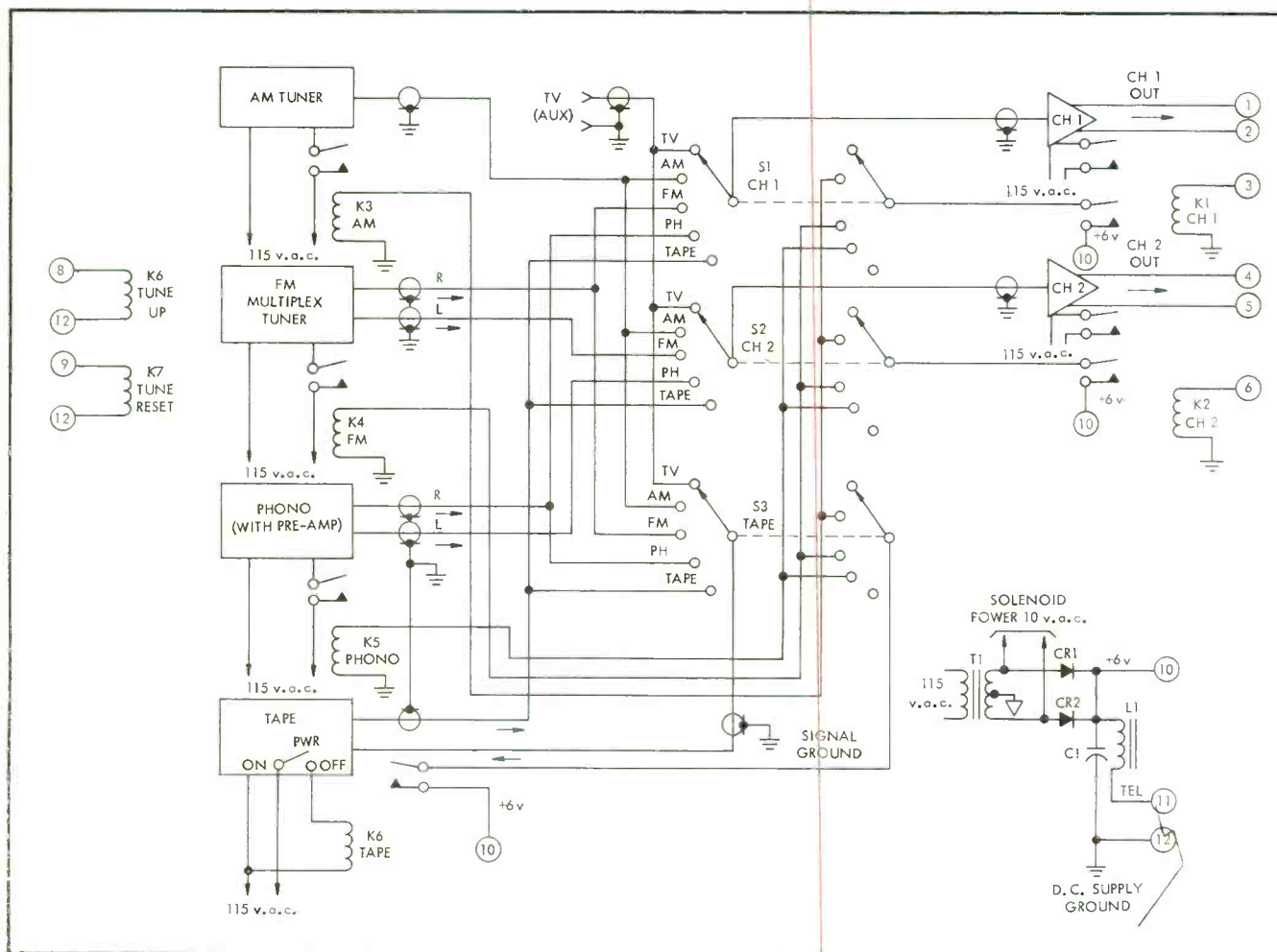
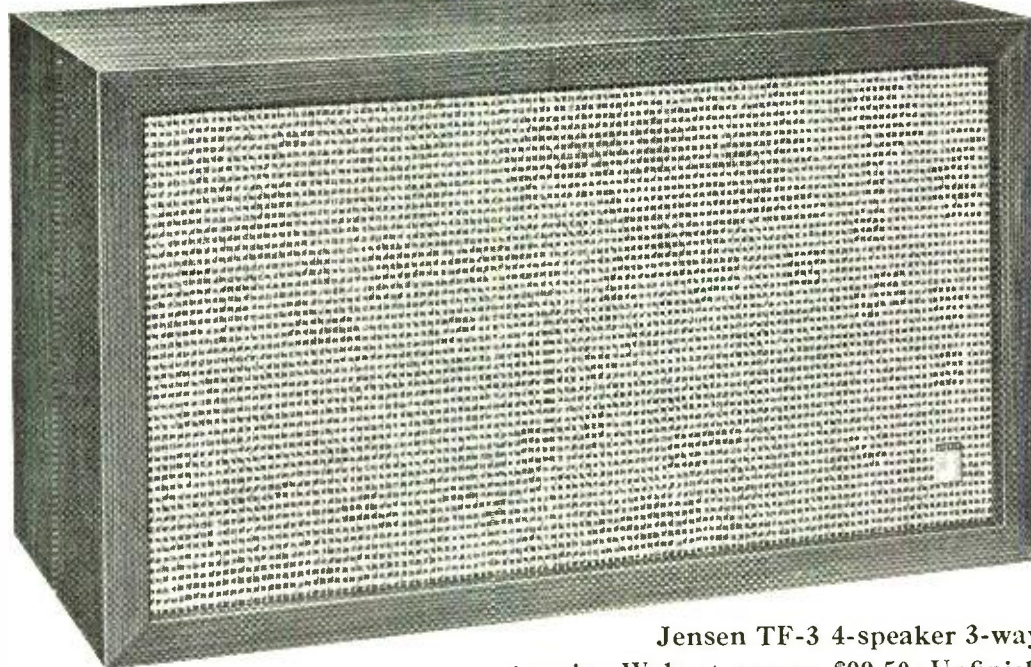


Fig. 3. Amplifier input-output connections.

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The precise fraction is a matter of opinion, but the fact of the matter is not. In addition to the many thousands of hi-fi systems with TF-3's, quite a few are using speaker systems that are simply not as good. ■ Some were chosen because their owners expected more bass response, or smoother bass response. Those who bought closed-box systems, for example, get no more bass than the TF-3 provides. Moreover, a closed-box system has nearly 4 times as much distortion at 40 cycles as a TF-3. ■ And the TF-3 is efficient. It would have effectively doubled the power of amplifiers being used compared with some less efficient types of loudspeakers. Or, you could have used a smaller amplifier, obtained the same sound level, and pocketed about \$50. ■ While we're saving money—a pair of TF-3's are priced as much as \$60 less than a pair of alternatives that do not work as well. Take this, and the amplifier savings and you have about \$100. Or, would have had about \$100. ■ And, you would have had a better *looking* system. The selected panels used to make a TF-3 are veneered with choice real walnut, carefully hand-finished. (Some people don't use real walnut . . . you should have asked.) If you had bought the unfinished TF-3 at \$79.50, you could even have painted it to match the drapes. ■ If you already own TF-3's, you're lucky. On second thought, you're probably just smart.



Jensen TF-3 4-speaker 3-way system in genuine Walnut veneer, \$99.50; Unfinished, \$79.50.

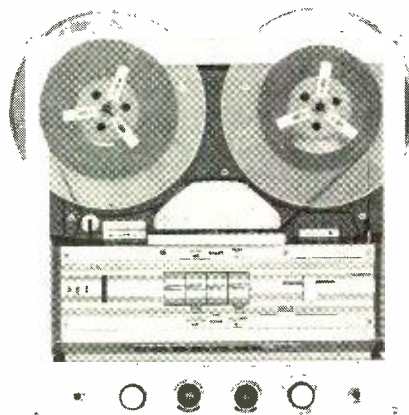
JENSEN MANUFACTURING COMPANY / DIVISION OF THE MUTER COMPANY / 6601 SOUTH LARAMIE AVENUE, CHICAGO 38, ILLINOIS
 Canada: Radio Speakers of Canada, Ltd., Toronto • Argentina: Ucoa Radio, S.A., Buenos Aires • Mexico: Fapartel, S. A., Naucalpan, Mex.

the most
versatile selection
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in music history...
bar none!

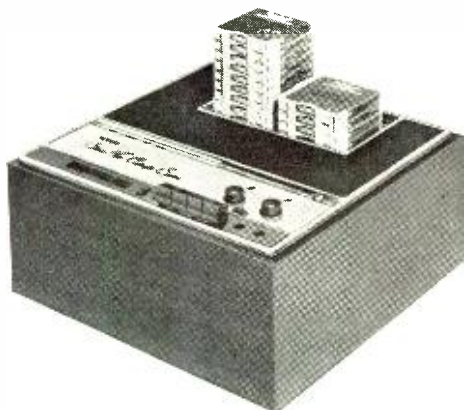
REVERE-WOLLENSAK PRESENTS four different tape decks . . . four unique custom music applications . . . four of the finest designed and constructed instruments you can buy. Whatever your taste in tape, one of these magnificent custom installations will not only satisfy, but excel even your fondest music expectations. Both the two Wollensak reel-to-reel units and the exciting new Revere Cartridge Systems incorporate traditional long term reliability, ease of operation and precision performance that assure unequaled sound reproduction. Looking for the best in custom installations? You'll find them on the next page. Then take your pick . . . at your nearest Revere-Wollensak dealer.



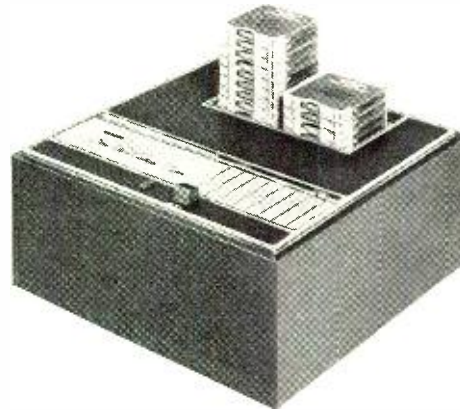
WOLLENSAK 1981 "SOUND ROOM" STEREO TAPE DECK Designed for the serious tape recordist, incorporating two new module-type recording and playback amplifiers which provide 22 watts output. Superb stereo or mono recordings can be made from any sound source. Vertical or horizontal operation . . . 2 VU recording meters . . . tab control tape drive, speed selection . . . sound on sound and sound with sound . . . digital tape counter . . . automatic tape lifters . . . complete professional sound advantages. **SIZE:** 21½" x 13¾" x 9 5/16". **WEIGHT:** 42 pounds.



WOLLENSAK 1780 STEREO TAPE DECK For the sound perfectionist who wants to incorporate top quality Wollensak stereo recording and playback facilities in an existing sound system, but does not require playback amplifiers and speakers. Installed either vertically or horizontally. Dual matched record/playback preamplifiers . . . sound with sound . . . cadmium steel enclosure with chrome trim . . . easy-to-operate tab controls . . . volume control for each channel . . . automatic shut-off . . . automatic tape lifters . . . many more outstanding sound-on-tape features. **SIZE:** 13¾" x 14" x 5½". **WEIGHT:** 15 pounds.



REVERE M20 STEREO TAPE CARTRIDGE DECK (RECORD/PLAYBACK) The newest idea in music now for custom installation! This amazing machine threads, plays, rewinds, changes tapes automatically. Up to 15 hours of uninterrupted music just by touching a button. Dual record/playback preamplifiers (minus power amplifiers and speakers). Record in stereo or mono from any sound source, or choose from a wide assortment of pre-recorded tapes. Keyboard controls . . . digital tape counter . . . high speed search lever . . . automatic and delayed shut-off . . . unsurpassed sound-on-tape reproduction. **SIZE:** 13 11/16" x 13 13/16" x 7". **WEIGHT:** 32 pounds.



REVERE M30 STEREO TAPE CARTRIDGE DECK (PLAYBACK) The tape player even more convenient than an automatic record player, designed for the custom music aficionado who requires playback only. A beautifully made unit that threads, plays, rewinds, changes tapes automatically! Dual playback preamplifiers (minus power amplifiers and speakers). Simple one key operation that allows up to 15 hours of superb uninterrupted stereo sound. The Revere System is the most exciting development in tape recording history . . . the most automatic means of enjoying stereo tape reproduction at its finest. **SIZE:** 13 11/16" x 13 13/16" x 7". **WEIGHT:** 32 pounds.

Revere-Wollensak Division
ST. PAUL, MINNESOTA 55119



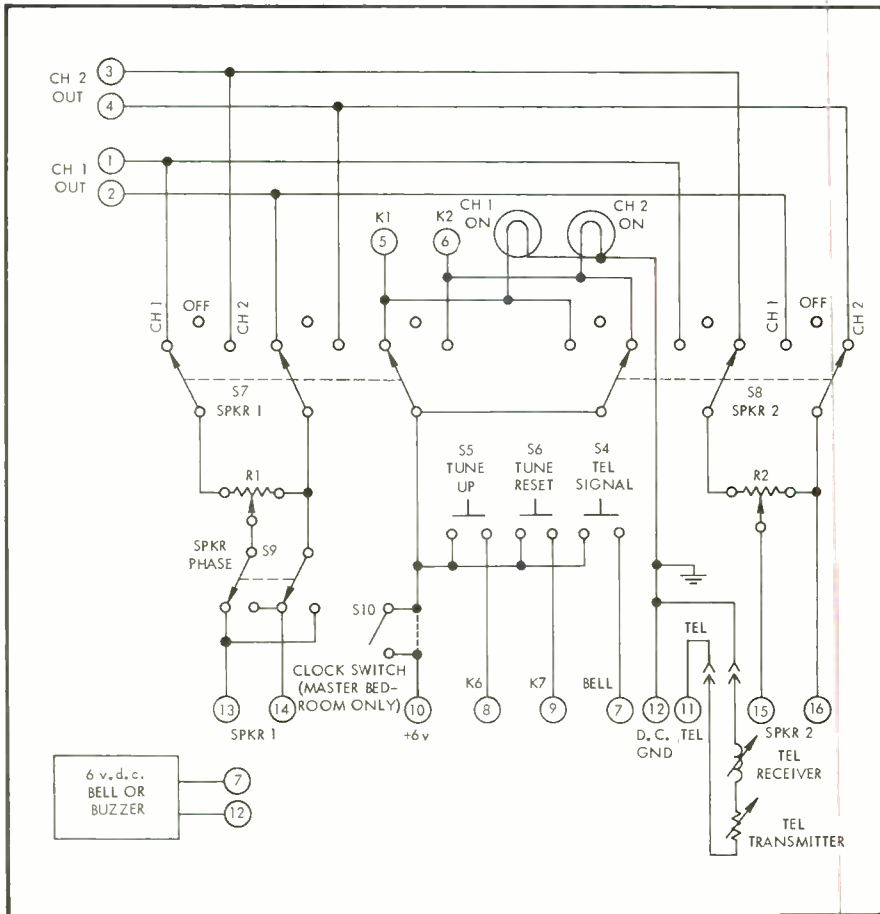


Fig. 4. Control unit connections.

and S_8 , and volume controls R_1 and R_2 , for each of two speakers. The center position of each channel selector is off, and if all other channel selectors in the house are turned off the system will be totally off. Turning a selector to the left turns on channel 1 and feeds audio through the volume control to the speaker. The right position controls channel 2. Thus, with the two sets of controls, one may set up a stereo program, or both speakers may be set to one channel for monophonic listening.

Switch S_9 , on the side, controls phasing of one of the speakers. Two small pushbuttons on top (S_6 and S_7) provide full remote station selection for the FM tuner. Pushing S_5 instantly steps the tuner from station-to-station up the dial. Each brief operation of this button brings in a new accurately tuned station. Pushing S_6 resets the tuning mechanism to the first station on the dial. Thus, if you don't happen to know where you are on the dial you need only to operate reset button S_6 and then use S_5 to advance the required number of steps to the station you want. Even with over 20 stations coming in, my family has no difficulty tuning.

The small button (S_7) and phone jack on the back are used as a bell signal and connector for a telephone intercom that operates over the same compact cable as

the hi-fi system. The telephone provides convenient room-to-room communication without the annoyance of conventional "squawk-box" loudspeaker intercoms.

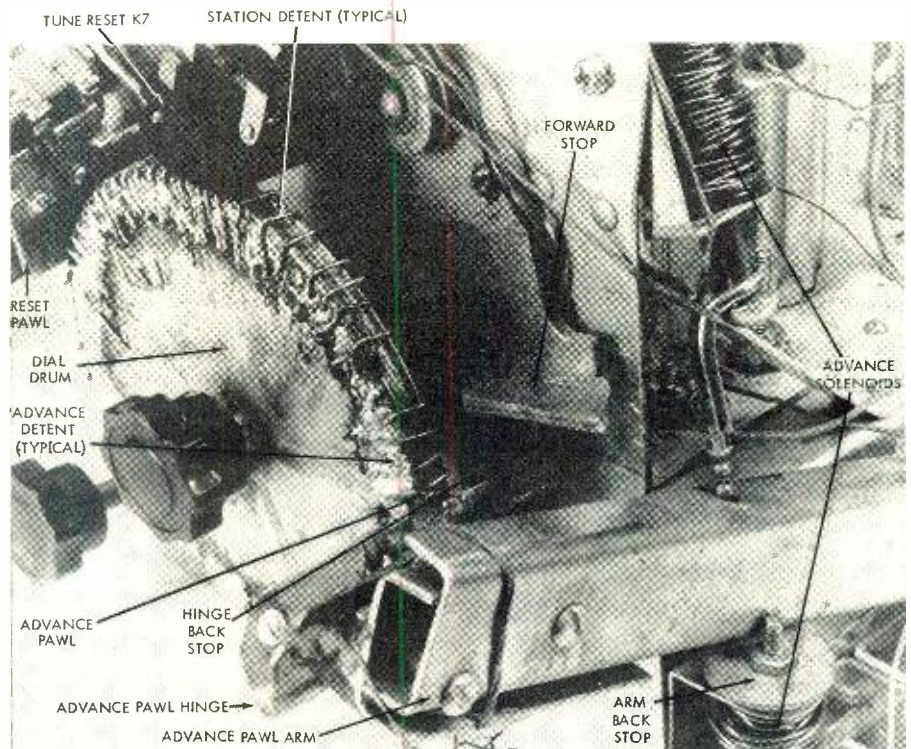


Fig. 5. Tuning mechanism construction.

The FM and AM tuners and both audio amplifiers are located on a shelf in the basement. This not only conserves living area, but keeps the working gear easily available for maintenance.

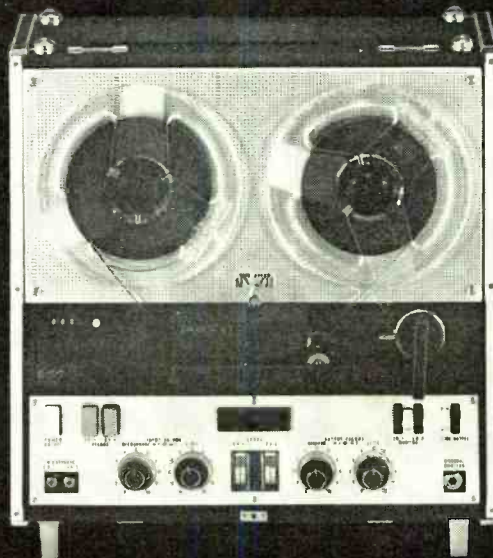
I don't use a turntable, although switching is provided for future use. A tape recorder is located in our den, with the piano. A channel assignment control box on the underside of the tape recorder shelf (Fig. 2) includes three switches for selecting the input to each of the two channels (S_1 and S_2) and to the tape recorder (S_3). Any program source, including AM, FM, tape, or plug-in phone or TV audio, may be fed to any channel. Thus the system permits full stereo listening (from FM multiplex, AM-FM radio, phone, or tape) or listening to separate programs, on each of the channels, in different parts of the house. For those rooms where monophonic listening is adequate, S_7 , S_8 , and R_1 can be left out.

Although I have not needed it, the basic system can be expanded to include indicator lights to signal various functions, or, by means of switches and a detent on the dial drum, to indicate when key stations have been selected. The schematic diagrams for the system (Fig. 3 and 4) include "channel on" indicator lights which could be placed in each control box to show what parts of the system are in use.

One very helpful feature which I have included is a clock timer. Such timers are generally available. The clock switch is connected in series with the 6-volt d.c. supply for the control unit in the master



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Professional in every detail, from its modular circuitry to its 3-head design, this superb 4-track stereophonic and monophonic recording and playback unit provides such versatile features as: ■ vertical and horizontal operating positions ■ sound on sound ■ tape and source monitor switch ■ full 7" reel capacity ■ microphone and line mixing ■ magnetic phono and FM stereo inputs ■ 2 V.U. meters ■ hysteresis-synchronous drive motors ■ dynamically balanced capstan flywheel ■ automatic shut off ■ pause control and digital tape counter—all indispensable to the discriminating recording enthusiast. Less than \$450,* complete with carrying case and two Sony F-87 cardioid dynamic microphones.

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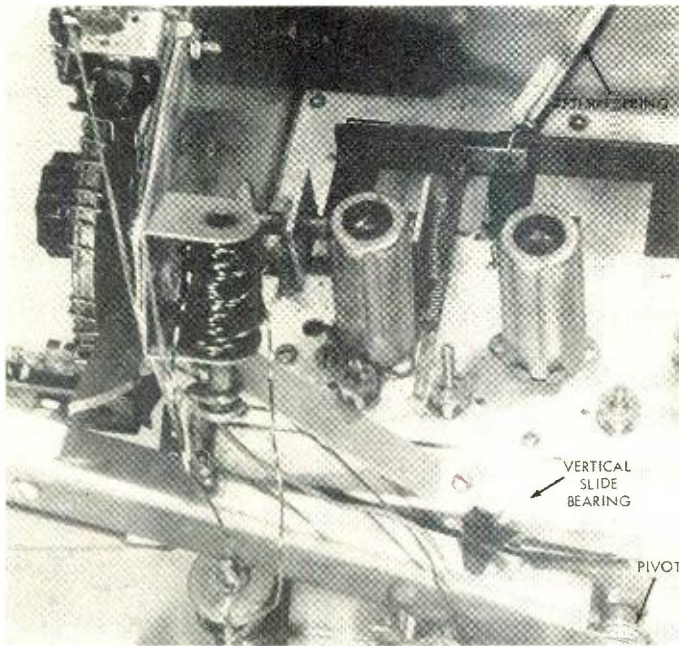


Fig. 6. Details of tuning mechanism.

bedroom so that it can turn off the system at night and turn it on again in the morning. This arrangement requires that all other control units be turned off at night. The clock switch could also be connected in series with the 6-volt supply for the entire system, so that all speakers which were turned on at night also come on in the morning. Additional features are limited only by the imagination of the user. For example, the tuner may be equipped with a relay circuit, operated from the 19-ke subcarrier, which will automatically feed the left channel to the channel 1 input and the right channel to the channel 2 input whenever FM stereo is on. Under monophonic conditions this relay circuit might feed FM to channel 1 and AM to channel 2. Relay K_5 , operated from the phono motor power circuit, might also be wired to override the tuner output and connect stereo phono output to the amplifier. The AM tuner could also be equipped with a remote station selector, if desired.

The heart of the system is the solenoid operated remote FM tuning mechanism, shown in Fig. 5 and 6. The dial drum (Fig. 5) is fitted with two sets of detent wires. One set engages a reset pawl, to hold the drum in position for each station, and the other set engages an advance pawl, to step the drum from station to station. The drum is spring loaded with a rubber band which serves as a return spring (Fig. 6). The return spring has two distinct purposes. It not only returns the tuner to the start position, when the reset pawl retracts, but it also biases the entire tuning drive system in one direction, to completely eliminate backlash. The location of this spring will vary, from one type of tuner to another, but in all cases it must be located with both functions in mind.

The reset pawl is a stripped relay;

that is with contacts removed. I used a 110-v a.c. relay as a convenient way of providing a strong positive latch. The 110-volt coil is powered through normally-open contacts of 6-volt tune reset relay K_7 . Station detents are soldered in place, one by one, to tune each station. The first station, at the initial reset position requires a small piece of angled sheet metal to act as an end stop.

The advance mechanism consists of an advance pawl, mounted on an advance pawl hinge. The hinge is spring loaded in the forward direction so that the advance pawl moves forward to engage an advance detent when the advance pawl arm is raised. At rest, the advance pawl arm is seated against the arm back stop, which is a flat washer on top of the lower solenoid plunger. In this position a hinge back stop pushes the advance pawl hinge away from the dial drum so that the advance pawl clears the advance detents. Thus the drum is free to rotate back to the start position when the reset pawl operates.

The drum is advanced when both solenoids are energized so that one pushes and the other pulls the advance-pawl arm up. The advance detents are soldered in place and spaced so that the drum rotates just past a station detent, and when the arm drops the return spring pulls the drum back so that the reset pawl engages a station detent. The amount of drum advance is controlled by both advance detent spacing and arm travel. Arm travel is limited by the forward stop. These limits assure that the drum is never advanced more than one station. This makes it possible to vary drum travel as required to accommodate various distances between stations. In some areas, where there are unassigned channels, extra "blank" detents may be required. A rubber band is also used to

pull the advance pawl arm down, for positive return. Use of two solenoids provides the required power over the required distance for the advance arm. As the lower (push) solenoid reaches the end of its power stroke the upper (pull) solenoid takes over. The lower solenoid screw stud acts as a side stop, to keep the advance pawl arm motion strictly vertical. The vertical motion is also restricted by the vertical slide bearing (Fig. 6), which is a piece of polystyrene rod. The arm rotates on a pivot made from a discarded volume control, some spacer washers, and a 1/4-inch shaft coupling.

The solenoids are taken from a door chime, and rewound to operate on 10-v a.c. I used #20 Formex wire to assure reliable operation even with the high current drawn when the relay is pulsed. A single high-thrust 110-v a.c. commercial solenoid could have been used. The tune-up relay, K_6 , has heavy-duty normally-open contacts to control this current. The 10-v a.c. is taken directly from the secondary of power transformer T_1 .

The telephone circuit uses choke L_1 as a shunt feed. All handsets are connected directly in parallel for party-line operation and kept "on" at all times. I have found no need to provide hookswitches or other means for disconnect. The handsets are standard items available from many sources for only a few dollars each. A parts list of suitable components is included at the end of the article. These parts are suggested items only. Other components with suitable ratings may be substituted. The power supply current will vary with the number of relays and lights employed and the type of solenoids used. If the telephone is omitted, an a.c. supply and a.c. relays could be used; however a.c. relays sometimes buzz and they can introduce audio hum unless great care is taken in laying out the wiring. Power supply voltage can range from 6 to 24 volts, but with voltages above 6 volts, care must be exercised to limit transmitter current through the telephone. At 12 or 24 volts, a series resistor could be used instead of choke L_1 for telephone shunt feed, but it should have a resistance of at least 100 ohms with adequate power rating. The resistance should be such that telephone current will be about 100 ma through each handset.

The cable used to connect operating equipment to the control points consists of nine pairs of #22 solid wire, with an over-all plastic jacket (Belden #8744). This cable permits a neat compact installation without the wife-upsetting wires which typify many custom installations. The connections to the speakers for each control point, through pairs 13-14 and 15-16, do not run to all points; that is, these pairs are for local service only. If

(Continued on page 77)

Why doesn't somebody make a changer cartridge based on the same principle as the ADC POINT FOUR, so that people who own changers can get the same kind of performance as people who own turntables?

SOMEBODY HAS



ADC 660

It was ADC, of course. After all, the revolutionary Induced Magnet principle that makes the Point Four so remarkable is ADC's own. The new cartridge is the ADC 660 Stereo Changer Cartridge, and its distinctive performance is the result of all the design benefits of the famous ADC Point Four and the Induced Magnet principle: the virtually weightless combination of hollow-aluminum stylus arm and soft-iron armature that makes for unbelievably low mass and high compliance (20×10^{-6} cm/dyne), the remote positioning of the fixed magnet that eliminates saturation and hysteresis distortion, the low-slung pivot point that produces an honest vertical tracking angle of 15° , and the ease and convenience of stylus replacement. Sound? As with the Point Four, we

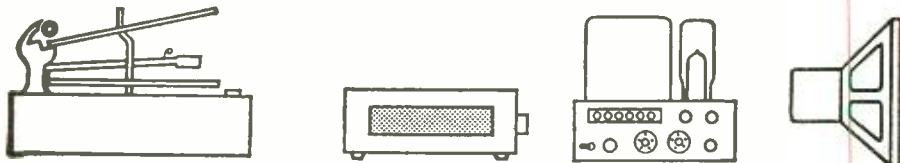
can only suggest that you hear it yourself—and with equipment that will do it justice.

ADC 660 Specifications: □ Type: Induced Magnet □ Sensitivity: 7 mv. at 5.5 cms/sec recorded velocity □ Channel Separation: 30 db, 50 to 8,000 cps □ *Frequency Response: 10 to 20,000 cps ± 3 db □ Stylus tip radius: .0007" (accurately maintained) □ Vertical tracking angle: 15° □ Tracking force range: $1\frac{1}{2}$ to 4 grams □ I.M. distortion: less than 1%—400 and 4,000 cps at 14.3 cms/sec velocity □ Minimum compliance, vertical and horizontal: 20×10^{-6} cms/dyne □ Price: **\$46.50**
*Frequencies above 15,000 cps will be influenced by the impedance characteristics of the amplifier and connecting cables. Load impedance may be varied to give the most pleasing results.



AUDIO DYNAMICS CORPORATION
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EQUIPMENT



PROFILE

CONCORD MODEL 884 STEREO TAPE RECORDER

From the standpoint of appearance, tape recorders have several things in common with one another—most of them have two reels disposed side by side on top, and near the front somewhere are a series of controls. In fact, they are so similar in general layout that anyone with only a little experience can begin to operate one almost immediately after opening the case.

But beyond that, they differ greatly in the features offered, in electronic circuitry, and in the mechanism proper. The new Concord 884 is the most up-to-date in this line, and it offers a multitude of attractive features built into a solid and sturdy mechanical chassis—the whole resulting in a recorder of convenience and high performance.

Physically, the unit is mounted in a plastic-covered, chrome-trimmed case measuring 16½-in. wide, 15½-in. deep, and 11½-in. high. This case separates at the center to reveal the recorder in one section and the extension speaker in the other, with a zippered compartment in the latter for microphones, additional cables, and the mike stands. A jack in the speaker case mates with an accessory cord which plugs into the recorder case when the unit is used for stereo reproduction.

The recorder has the usual two tape reels over a brushed stainless steel cover plate, giving a professional appearance, and fronted by the control "console" which houses the two level-indicating meters, speed-selector switch, digital counter, tape-or-source monitor switch, and the two channel-record-indicator lights. Along the front are dual-concentric record- and playback-level controls, a ganged volume control for the speaker level combined with the power switch, six black piano-key operating controls—REWIND, STOP, FAST FORWARD, PLAY, and CH.1 and CH.2 RECORD. Between the PLAY and RECORD keys is a pause key, narrower than the others and finished in chrome to distinguish it. At the far right is the ganged tone control.

At the left side of the case is a recessed 2½-in. x 8-in. panel covered by a hinged door to provide storage space for the power cord, and access to the inputs and outputs of the circuit, as well as two switches—one for sound-on-sound operation, and the other for mono operation of either channel or for stereo speaker operation. Phone jacks are provided for the two microphone inputs, phono jacks for the high-level "aux" inputs and for line outputs, and a three-circuit jack is provided for monitor phones, with a built-in 180-ohm resistor in each channel for use with low-impedance phones. Input imped-

ance for the microphone circuit is 20,000 ohms, and for the auxiliary inputs it is 100,000 ohms, resulting from a series resistor between the two jacks. Thus all inputs are fed through the entire amplifier. The record amplifier consists of four transistorized stages—the first two with feedback equalization around them to provide low-frequency boost, the third an emitter follower, and the fourth with high-frequency equalization across the emitter resistor. The record head is fed from this fourth stage, as is another transistor stage as a level-indicator driver.

The playback preamp is similar, with low-frequency equalization provided by feedback around the first two stages, while the fourth stage feeds a 6BQ5 tube output stage in both channels. Additional transistor stages fed from the third stage of the playback preamps provide the line output. The erase/bias oscillator is a 12BH7 working at approximately 79 kc.

The speed selector knob switches in the fixed components of the equalization networks, but variable resistors are employed in the playback preamp to permit adjustment of response accurately at the two higher speeds—3¾ and 7½ ips. Switching is provided for cross-connecting the two channels for sound-on-sound recording, and for selection of the monitor signal from either the record preamp—and thus the source material directly—or from the playback preamp so as to monitor the signal actually recorded on the tape. The tone control does not affect either the recording or the line output, but only the loudspeaker and phone monitor outputs.

Simple addition will indicate that the unit employs a total of 20 transistors and three vacuum tubes.

Operation

From the standpoint of actual operation, the Concord 884 was found to be all that one could ask of any but an all-solenoid-operated machine. Try as we might, we were not able to spill tape nor to break it. Faulty operational procedure could cause the tape to wrap around the capstan, but it could be unwound without removing the head cover. The cue key permitted editing, although the tape was somewhat hard to pull past the heads. The two microphones furnished, both with small table stands, gave excellent voice quality, but we did not have any live music available for comparison on the more critical sources. The external speaker, normally used on the right channel when reproducing stereo, was well matched to the built-in speaker for the left channel. The external speaker can be plugged into the left-channel output to cut off the internal speaker if desired. Feeding the line outputs into another complete system with larger speakers gave quality comparable to that of the normal output from the system. In short, the 844 is a really nice machine to use, attractive in appearance, and—if weight is any criterion—solidly and sturdily built. The complete machine, with accessories, weighs 43 lbs.

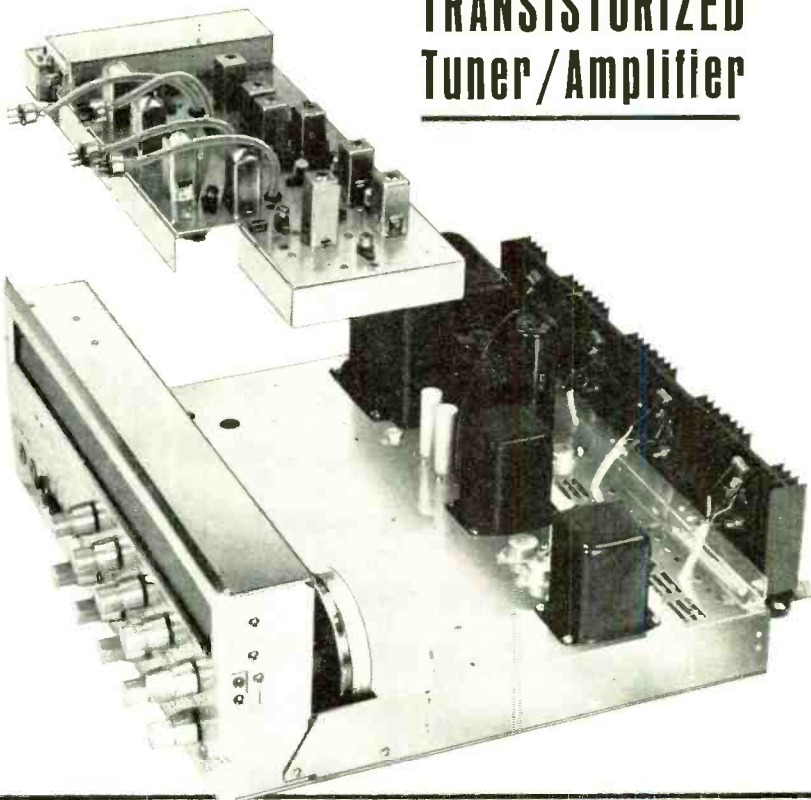
Performance

Our performance tests consist primarily of two parts—measuring the output from Ampex standard tapes 31321-01 and 31331-01 respectively for 7½ and 3¾ ips (we do not have such a tape for 1½ ips), and then recording a series of frequencies and playing them back and tabulating the outputs. After the frequency measurements are made, we then check hum and noise, flutter and wow, tone-control action. For the record playback measurements, we record at the level indicated in the instruc-

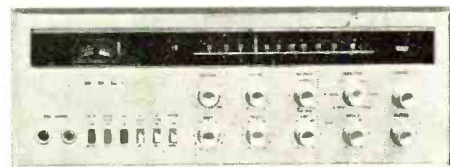


Fig. 1. The Transistorized Concord Model 884 Stereo Tape Recorder.

EXCLUSIVE *Bell* DESIGN
Start with Amplifier
...plug in Tuner later!

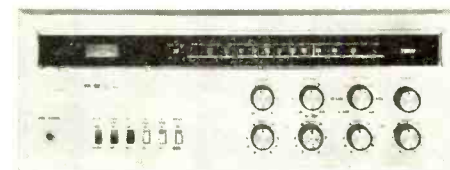


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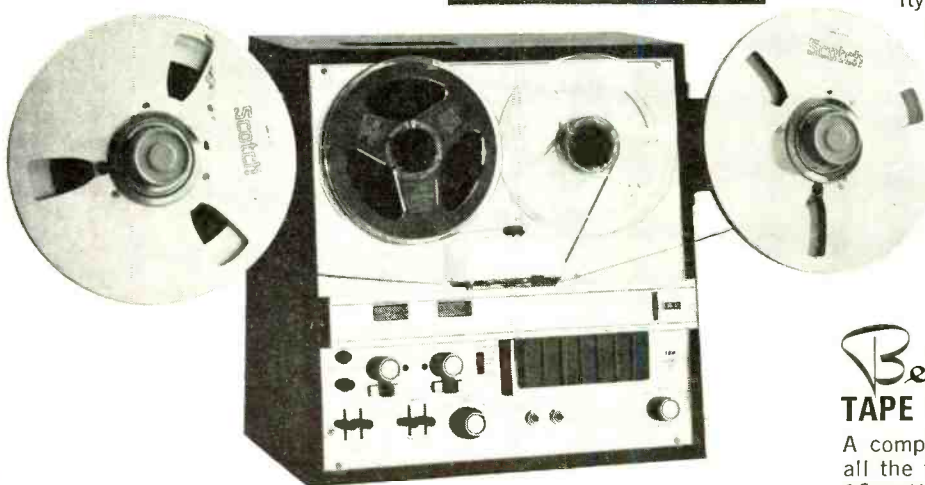


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Outstanding technical performance nearly equal to Imperial 1000 • Transistorized • Ultra-high tuner sensitivity • 80-watt power output... 9 to 75,000 cycle amplifier response ... \$469.95

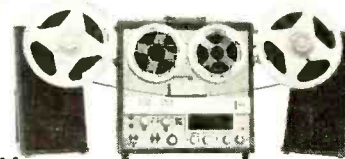
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Now... a single tape deck that will make copies of pre-recorded tapes... record and playback high fidelity stereo or monaural tapes • Echo and sound-on-sound flexibility • Off-the-tape monitoring • Three-motor drive • Electro-dynamic braking • Attractive polished-chrome deck plate with contrasting black ebony housing... T-367 \$369.95 ... DK-1 Duplicator Motors \$49.95. EB-1 Housing \$24.95



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A complete portable stereo recorder with all the features of the T-367 plus built-in 16-watt stereo amplifier and swing-out speakers ... RT-360 \$449.95 ... DK-1 Duplicator Motors \$49.95

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tions, checking for on-the-tape distortion. It is usual that the maximum operating level, as indicated in the instructions, is at the point where tape distortion is 3 per cent harmonic.

The following tables show the figures gleaned from our measurements. Only one channel is shown, but both were within ± 2 db throughout.

Standard Playback Tapes

Freq.	7½ ips	3¾ ips
Ref	0 db	0 db
15,000	+2.0	
12,000	0.0	
10,000	-1.5	
7500	-1.2	+1.5
5000	-1.0	+1.0
2500	-0.4	+0.5
1000	0.0	0.0
500	+0.8	-0.2
250	+0.5	-0.2
100	+2.7	-0.5
50	-0.5	0.0

Record/Playback

	7½ ips	3¾ ips	1½ ips
20,000	-1.5		
15,000	-1.0		
12,000	0.0		
10,000	+0.6	-1.0	-2.7
7500	+2.0	-1.2	-2.3
5000	+1.5	+3.0	-2.0
2500	+0.4	+2.0	+1.8
1000	0.0	0.0	0.0
500	+0.6	0.0	-1.2
250	+0.3	+1.3	-1.3
100	+1.0	+2.0	-3.4
50	-2.2	+1.3	-2.2

Signal to Noise ratio 58 db

Tone Control Range

15,000	+5.5 to -26 db
12,000	+6.0 to -25 db
10,000	+5.5 to -23 db
7500	+5.5 to -10.5 db
5000	+4.5 to -7.0 db
2500	+1.5 to -4.0 db
1000	0.0 to 0.0 db
500	+3.0 to -1.0 db
250	-3.8 to -2.5 db
100	+4.3 to +5.0 db
50	+2.0 to +2.3 db

Flutter and wow 0.15 per cent at 7½ ips
0.20 per cent at 3¾ ips

In comparison with the usual hi-fi tape recorder in its price range, the Concord 884 should be able to show up most favorably in both performance and convenience of operation. C-18

DYNAKIT MODEL SCA-35 STEREO CONTROL AMPLIFIER

In last November's issue, we profiled the Dynakit Stereo-35, a simple two-channel basic power amplifier modest output. Now comes the same output section, essentially, preceded with a preamplifier section and assembled (by the kit-builder) in an attractive case with all of the necessary controls to provide the facilities normally required in a hi-fi system.

This little unit (it measures 13¼ in. wide, 12 in. deep over control knobs and fuse knob and 4¼ in. high) is a delightful little performer which should require not over twelve hours to build and which should give complete satisfaction in installations where its combined 35 watts (both channels) is adequate, and that means in any installation which does not include any of

Fig. 2. The Dynakit SCA-35 Stereo Control Amplifier.



the low-efficiency speaker systems. It has seven pairs of inputs—magnetic phono, low level, ceramic phono high level, tape head, tuner, tape amplifier, and spare. It provides a constant-level tape output to feed a recorder, and 8- and 16-ohm loud-speaker outputs. Instructions are provided for connecting a headphone jack, as well as for feeding a "center-channel" speaker. The front panel mounts a input selector switch, volume, balance, bass, and treble controls, a loudness compensation switch, a filter switch, and a power switch, along with a pilot light.

As in the Stereo 35, the amplifier sections are mostly built at the factory on printed-circuit panels, one section for each basic amplifier (right and left), and one section containing the two preamp tubes and associated circuitry. The preamps each use one 12AX7 with the usual feedback-provided equalization. The output amplifiers are identical with those of the Stereo 35, and employ one 7199 and two 6BQ5's in each channel. The power supply uses silicon diodes.

Performance

Frequency response is flat within 0.5 db (or better) from 20 to 20,000 cps, and equalization curves match the RIAA phono curve or the NAB 7½ ips tape curve within better than 2 db throughout the range. Power output measures 17 watts per channel at less than 0.8 per cent IM distortion, and harmonic distortion is well under 1 per cent at 17.5 watts. Hum and noise measured 72 db on low-level inputs and 84 db on the high level inputs.

The SCA-35 is so small and simple that there is not much that can be said about it except that it is perfect for a small installation where excellent quality, simplicity of construction and operation, and attractive appearance are requisites. C-19

ADC POINT FOUR STEREO PICKUP

The ADC Point Four is one of the new breed of stereo pickups. If you have been reading the articles by Woodward on reducing distortion in stereo phonograph systems (concluding in this issue) you know that one must reduce stylus mass, reduce stylus-tip diameter, and set the vertical tracking angle at 15-deg. in order to materially reduce tracking and tracing distortion. The ADC Point Four has taken several giant steps towards this goal. (Realize, of course, that giant steps in relation to cartridges are not literally large, just relatively.)

The key thing here was reducing the stylus mass. By doing this they could then reduce the stylus-tip radius (Woodward and other authorities point out that stylus mass and radius are interrelated) to the 0.4-mil

dimension which undoubtedly inspired the model number designation.

The method whereby the stylus mass is reduced is quite ingenious, and requires a bit of background to understand. Most modern magnetic pickups induce a signal into one or more of four symmetrically located coils (actually the pole pieces of the coils) by waving a magnet in front of them, the waving hopefully an exact representation of the modulation of the record groove. In order to have the waving magnet exactly reproduce the groove modulations it is usually on the "other end" of the stylus bar. (The "other end" is the one away from the tip.) Thus the stylus assembly has a considerable amount of mass (relatively) because of the magnet on the end of the bar. Instead of a magnet on the end of the stylus bar, the Point Four has a light collar (they call it an armature) of soft iron tubing. This collar does the work of a magnet because it is constantly magnetized by a large permanent magnet located near the collar, which is *not* part of the moving system (the white metal structure behind the stylus in Fig. 3). Almost like having your cake and eating it too. ADC calls it an "induced magnet transducer."

In order to achieve the 15-deg. vertical angle the pivot point had to be brought close to the record surface. This was done by off-setting the pole pieces so that they are much closer to the record surface. (See Fig. 4.)

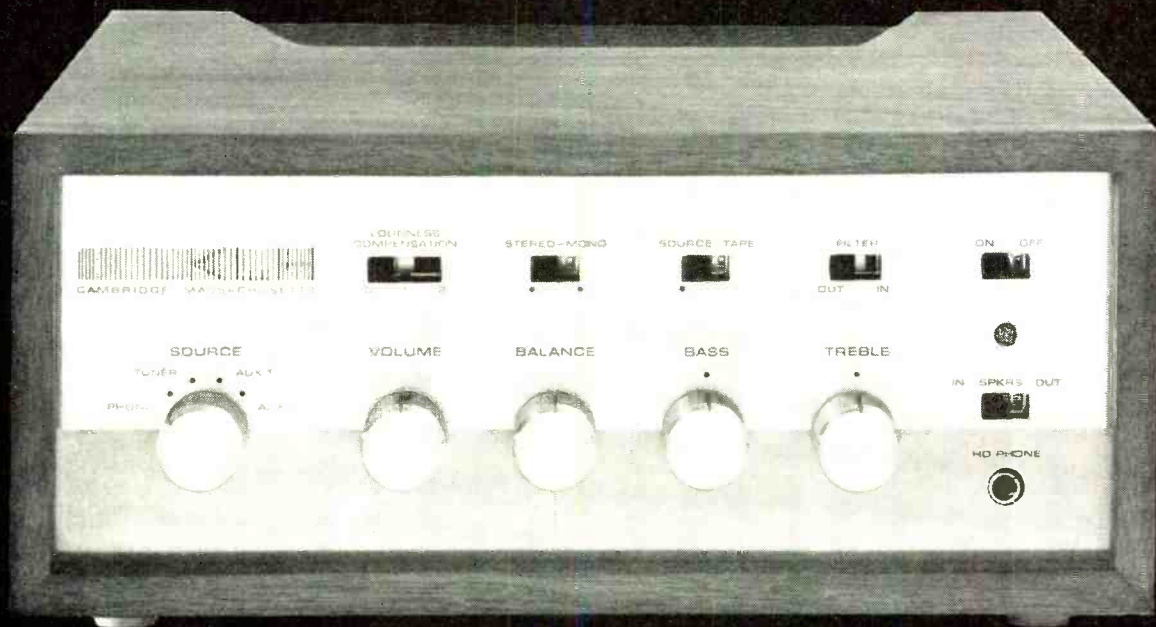
The stylus assembly is exceptionally easy and convenient to replace; just slip off the entire front section as indicated in Fig. 4.

An additional feature is that the stylus is set to retract with a tracking force exceeding about 3 grams. This is in keeping with the current trend to protect records from inadvertant abuse (and to protect the stylus itself).



Fig. 3. ADC Point 4 Stereo Pickup.

To fulfill every musical requirement
in a home music system



The KLH Model Sixteen Transistorized Integrated Music Amplifier

- The Model Sixteen will satisfy every musical requirement of the knowledgeable home listener, even if he is quite willing to spend more.
- 22 transistors, 8 diodes
- Stereo power output is a minimum of 90 watts music power (45 watts per channel), 70 watts steady state, on a full power band width of 20 to 20,000 cps, into 8 ohms (2 db less into 16 ohms).
- Complete protection against accidental shorting or opening of speaker leads
- Controls: On-Off, Program Source, Volume, Balance, Bass, Treble, Loudness Compensation, Stereo-Mono, Tape Monitor, High Frequency Filter, Speakers In-Out
- Inputs: Phono, Tuner, Tape, Aux. 1, Aux. 2
- Outputs: Speakers, Record, Headphones
- Dimensions (in cabinet): 5-3/4"H x 12-1/2"W x 10-1/4"D
- Guaranteed (parts and labor) for 2 years in normal use
- \$219.95; Oiled walnut cabinet \$19.95. Slightly higher in the west

The Model Sixteen is a newly developed, transistorized, stereophonic amplifier-preamplifier, designed to satisfy, without compromise or quibble, the requirements of the great majority of listeners who want high quality music reproduction in their homes. Through a careful selection of the performance characteristics essential to the reproduction of music, and a full exploitation of the advantages now available through the use of transistors, we have been able to produce an amplifier which is moderate in price, yet will meet the needs of listeners who insist on the highest quality. The Model Sixteen is uniquely compact in size, light in weight and simple to use. Since its performance will not deteriorate with use, it is reliable beyond the potential of any tube amplifier. There is no inherent aging process that will cause a transistor to wear out, as vacuum tubes do. Most important of all, the Model Sixteen sounds, while playing music at the same relative levels heard in the concert hall, indistinguishable from the most expensive amplifiers available.

Completely Transistorized

The Model Sixteen delivers the transient peak power performance and the trouble-free dependability that are now possible with the development of sophisticated solid state devices. It is no accident that the Model Sixteen was created by a company which has already made more high quality transistor amplifiers than all other component manufacturers combined.

KLH designed it. KLH builds it.



KLH RESEARCH AND DEVELOPMENT CORPORATION
30 CROSS STREET, CAMBRIDGE 39, MASSACHUSETTS

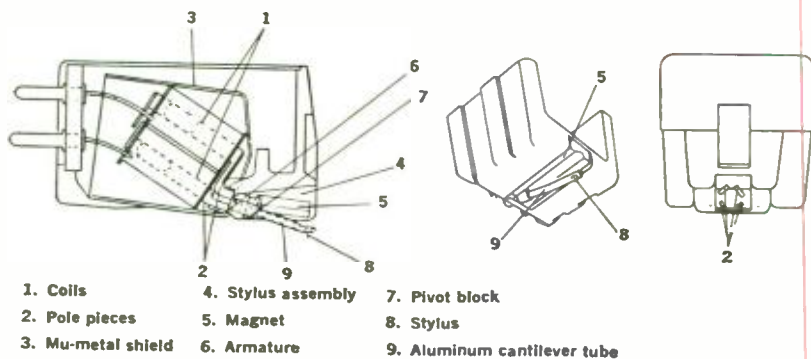


Fig. 4. Construction of ADC Point 4.

Performance

The ADC Point Four is a distinct improvement over preceding cartridges made by the company, which were also quite excellent.

The frequency response, using the CBS Labs STR-110 test record, indicated a relatively flat characteristic from 10 cps up to 2500 cps where a 2-db dip showed up. The dip extended out to 10,000 cps and then the response went up to a 1.5-db peak at 16,000 cps. There the response curve turned downwards, crossing the 0-axis at 18,000 cps and extending down 5-db at 20,000 cps.

Separation was 24 db at 1000 cps, 35 db at 6000 cps, 24 db at 10,000 cps, and 20 db at 16,000 cps.

IM distortion (400 and 4000 cps) never exceeded 3 percent at an extremely high groove velocity, and descended to less than 0.5 percent at a groove velocity of 12 cm/sec.

Output at 5.5 cm/sec. was 5.2 mv. Tracking force for all tests was 1.7 grams, although we were able to track well at a force of 1 gram. Compliance is claimed to be 30×10^{-9} cm/dyne. We couldn't check it, but it was undoubtedly very high.

In listening tests the ADC Point Four turned in a very musical performance. Clearly indicated by its response characteristics, it can handle low frequencies exceptionally well and exhibits a touch of brightness at the top end. It handles transients as well as any pickup we have tested to date, showing up to great advantage on heavily-modulated piano passages.

In sum, the ADC Point Four is one of the best cartridges available and should be listened to by anyone interested in a new cartridge.

C-20

FISHER XP-10 CONSOLETTA SPEAKER SYSTEM

The Fisher XP-10 was introduced in the latter part of 1963 and represents the crowning achievement of the Fisher line of loudspeakers. It is a three-way system encompassing a 15-in. woofer, an 8-in. midrange speaker, and a "soft dome" hemispherical tweeter.

Before going forward with an explanation and description of this speaker system, it might be worthwhile to look back briefly. If our memory serves us correctly, Fisher has been making speaker systems for only a few years, and yet some trade sources indicate that they are amongst the top few in current popularity. A rather striking performance which has been largely un-

heralded. Undoubtedly part of this success was due to the fact that the Fisher name was on these speakers. Equally important, however, was the fact that the progression of systems have been excellent performers for their day and age, and have been consistently upgraded over the years. Thus we arrive at their best and most elaborate system to date.

The XP-10 is also the finest piece of speaker furniture produced by Fisher, which is only partially indicated in Fig. 5. Measuring 24 $\frac{3}{8}$ -in. wide, 30 $\frac{1}{2}$ -in. high, and 14 $\frac{3}{4}$ -in. deep, it makes an unusually handsome piece of furniture with its Scandinavian Walnut exterior. Now let us take a look at what lies beneath that exterior.

The Woofer

The 15-in. woofer features the eddy-current damped electrolytic-copper voice coil which was introduced in the Fisher XP-4A. This technique provides excellent damping, and thus excellent transient response. The open air resonance of this speaker is 18 cps, and in the enclosure provides good output in the 30-cps region. The crossover frequency of 200 cps permits the woofer to operate in its most effective range and avoids some of the phasing problems resulting from a higher crossover point. The low-frequency driver utilizes a 6-lb. magnet structure.

Altogether, the 15-in. cone, the powerful driver, the excellent damping, and the low crossover frequency combine to produce clean and tight bass.

The Midrange Speaker

Often, the importance of the midrange speaker is overlooked, especially since it is usually the least expensive speaker in a decent-quality three-way system. In fact the midrange does the lion's share of the work since it must carry the majority of the orchestral fundamentals. Just glance at one of those charts which show the frequency range of orchestral instruments if you want to be convinced.

In addition to doing all that work, it must also be a smooth bridge between the woofer and tweeter. We can't over-stress the importance of properly bridging the high and low frequencies in a three-way system; a poor bridge can make even the best woofer and tweeter sound somewhat poor.

The preceding makes us well believe the statement by the manufacturer that he tried literally hundreds of different com-

binations of parameters before the right combination was found. The final result is a midrange which is flat within 1 $\frac{1}{2}$ db. It required an 8-in. speaker with a 5 $\frac{1}{2}$ -lb. magnet structure, 1 $\frac{1}{2}$ -in. voice coil, and its own separate-from-the-woofer loading. The upper crossover frequency of 2500 cps was chosen as a good compromise between the major orchestra fundamentals and the increasing importance of dispersion with increasing frequency.

The Tweeter

The major innovation introduced in the XP-10 is the "soft dome" hemispherical tweeter. Usually, hemispherical tweeters have domes made of molded phenolic or spun aluminum, both very stiff substances. The assumption behind these stiff domes is the same as one would have in making a cone tweeter; they require a stiff, light material because of the frequencies involved. Unfortunately, these stiff domes have certain resonances which tend to show up above 10 kc.

The designer of this system reasoned that the hemispherical tweeter is different than the cone tweeter in that it is driven at its periphery so that there is a certain amount of structural strength (like an arch) making it unnecessary to use materials such as aluminum or phenolics. Instead he used rubber-impregnated cotton diaphragm and achieved the same excellent dispersion and transient properties of the stiffer materials, without the characteristic resonances of those materials. (A patent is pending on the idea.)

Of course, to take advantage of the excellent properties of this tweeter, and to match it to the more efficient cone speakers, a 5 $\frac{1}{2}$ -lb. magnet structure with an air-gap flux density of 16,000 gauss was used. It is interesting to note that the magnetic circuit on this tweeter is more powerful than the circuit on many woofers—but of course this speaker is much, much less efficient.

Performance

In order to gauge the performance of the XP-10, we decided to go through extensive listening tests in addition to the usual microphone pickup tests.



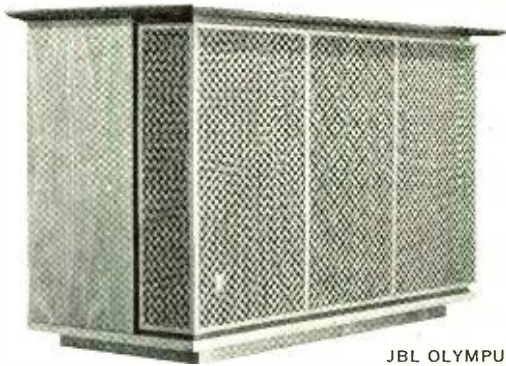
Fig. 5. The Fisher XP-10 Consolette Speaker System.

WILL YOUR ULTIMATE PRECISION LOUDSPEAKER BE

A JBL LINEAR-EFFICIENCY SYSTEM

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To the concept of long linear cone excursion James B. Lansing Sound, Inc., adds JBL precision workmanship, extremely close tolerances, and the largest voice coils made anywhere. When Linear-Efficiency transducers are mounted in a *compact* enclosure, the full-range coverage they provide is miraculous indeed. And when the same principles are applied to a full size system, "ultimate" is a most apt description.



JBL OLYMPUS

...OR A JBL HIGH EFFICIENCY SYSTEM

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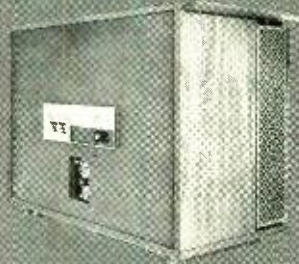
JBL makes the most efficient loudspeakers in the world, the only transducers with four-inch voice coils. JBL efficiency is the result of advanced magnetic circuitry, tight tolerances, and the large amount of conductor in the gap provided by large voice coils made of wire ribbon wound on its narrow edge. This gives them a dynamic range, transient response, presence, and an evenness of coverage without equal.



JBL C37

ALL JBL SPEAKER SYSTEMS ARE AVAILABLE SELF-POWERED

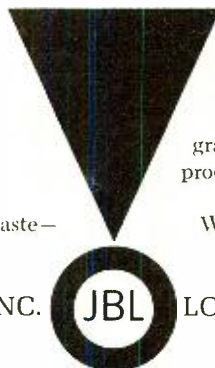
In a JBL Energizer/Transducer, loudspeakers and power source are engineered as a unit, perfectly matched to reproduce a preamplified signal with a purity that has no precedent. All solid-state construction is used in the energizer. Generating negligible heat, non-microphonic, it can be mounted in and become a part of the acoustical enclosure.



It is without hum, and distortion in any form approaches the vanishing point. It is not subject to the creeping degeneration common in vacuum tube devices. With custom matching of energizer and transducers, exactly the right damping is provided at all frequencies. Transient response of an Energizer/Transducer has never been equalled.

JBL OFFERS YOU MORE WAYS TO MAKE YOUR SYSTEM YOUR VERY OWN

JBL recognizes the fact that the serious participant in the art-science of high fidelity is an enthusiastic individual. He wants his very own system, one not quite like any other he has known. To serve the need of each individual, JBL offers two basic types of loudspeakers in many models. They can be used in large systems or small systems, built-in or free-standing. JBL provides enclosures for every taste—



infinite baffle, bass reflex, folded horn ... acoustically excellent, at the same time beautiful furniture. You will find that JBL makes equipment you will find nowhere else — acoustical lenses, a passive radiator, integrated stereo ... All have one thing in common: JBL products are precision built for the talented listener who is implacably determined to own the finest. Write for a free copy of the JBL complete catalog.

JAMES B. LANSING SOUND, INC. **JBL** LOS ANGELES, CALIFORNIA 90039

First let us look at what the microphone revealed as far as frequency response and dispersion. The frequency-response curve was essentially flat (within 2 db) from 50 cps (our starting point) out to 16,000 cps. At 30 cps the curve was down 5 db and at 20,000 cps it was down 7 db. The dispersion was constant, within 3 db, over an angle of about 90 deg., which was as far as we measured. We noted that the high-frequency response was unusually smooth, thus corroborating the designer's contention concerning the soft dome. Indeed, our measurement of the midrange also agreed with his statements: it was well within the 1½-db variation he claimed. Beyond that, the unit we tested had a remarkably smooth response curve overall.

The listening tests were the best of all however. (They don't always agree with measurements, as you may well know.) We must report that the XP-10 is truly a step forward in smoothness, transient response, and musical quality. It handled percussion, piano, strings, brass, and what have you, as cleanly and precisely as any speaker system we know. We won't use that hackneyed term "best," because it is a meaningless term when applied to speakers, but we will say it pleased us immensely. You try it. C-21

PML CONDENSER MICROPHONE MODEL EC-61

The PML condenser microphone, Model EC-61 is a cardioid pattern microphone which measures 2 11/16-in. long and 1 1/16-in. in diameter, and weighs 1¼ oz., truly one of the smallest condenser mikes we have come in contact with.

But don't let the size fool you, the PML EC-61 is a whale of a performer. In fact, at its price (about \$110 plus \$50 for the a.c. power supply, or \$30 for the battery supply) it is a giant of a buy. We don't mean to mislead you, however, into thinking that this microphone is as good as the top professional condenser units, but it is surprisingly close, and much less costly. Its omnidirectional brother, Model EK-61, costs \$10 less.

One of the surprising things about the PML (in case you didn't know, that means Pearl Microphone Laboratories, and their home base is Sweden) is that the amplifying



Fig. 6. PML Condenser Microphone, Model EC-61.

Fig. 7. FURN-a-KIT Equipment Cabinet, 2600 Series.



ing device inside the miniature case is a vacuum tube, not a transistor. The tube type is XFY54 HIVAC, a type we had not heard of before.

The EC-61 provides a choice of output impedances: 50 ohms, 200 ohms, 600 ohms, or high impedance. A matching transformer with the appropriate number of taps is built into the power supply (both the a.c. and battery units) so that one need merely change the connections on the signal cable. The high-impedance connection bypasses the matching transformer and feeds directly from the plate of the tube. We used the high-impedance connection for all tests.

The microphone contains the Mylar-diaphragm condenser head, the amplifying tube, and the wiring carrying in the supply voltages and carrying out the signal. Of course there are the usual plate load resistors, dropping resistors, bias resistors, and so forth. The shield of the microphone cable is grounded to the case of the microphone, but the signal-carrying circuit is not grounded, even though it is unbalanced. The cable is terminated with a 5-pin male Tuchel connector. It is 10-ft. long.

The Power Supplies

The a.c.-powered supply is an elaborate affair with a 100 mA fuse and an indicator bulb on the primary side of the power transformer. On the secondary side it has a solid-state bridge rectifier with an unusually well-filtered circuit following it. It even uses a transistor as a regulator on the 1.5-volt heater supply. B+ is 62 volts.

In addition to the 5-pin female Tuchel which interconnects the supply and the microphone, there is a 4-pin female Tuchel for connecting the signal to the recorder, or wherever you choose. Just behind this connector, inside the supply, is the matching transformer.

The battery supply is essentially a battery box with the 5- and 4-pin female Tuchel connectors on one end, and with the impedance matching transformer inside. There is one additional circuit built in, a filter for the 67.5-volt battery. Apparently even batteries ripple.

Performance

The output of the EC-61 is as follows: 50 ohms, -64 db; 200 ohms, -56 db; 600 ohms, -50 db; High-Z, -40 db; at a pressure at 10 dynes/cm. The response is flat within 2 db from 30 cps to 5000 cps, then it went up 4 db at 10,000 cps, remaining on a plateau out to 17,000 cps and dropping down to -1 db at 20,000 cps and

then dropping off sharply. The noise level is 13 phons.

Obviously this microphone is worth considering by anyone who is interested in doing quality recording. Certainly it is the most inexpensive entrée into the condenser microphone category we know of. C-22

FURN-a-KIT EQUIPMENT CABINET KIT, 2600 SERIES

Every now and again we get an urge to do something different, at least different than our usual diet of electronic kits, microphones, amplifiers, and so on. We felt, also, that you would welcome a change too. Anyhow, the windup was that we built a furniture kit.

Before we even built the kit, in fact before we even got it, we ran into a serious problem. It seems that FURN-a-KIT provides so many options with respect to interior dimensions, interior setup, doors, and external decoration, that we almost gave up before we started. We couldn't make up our mind!

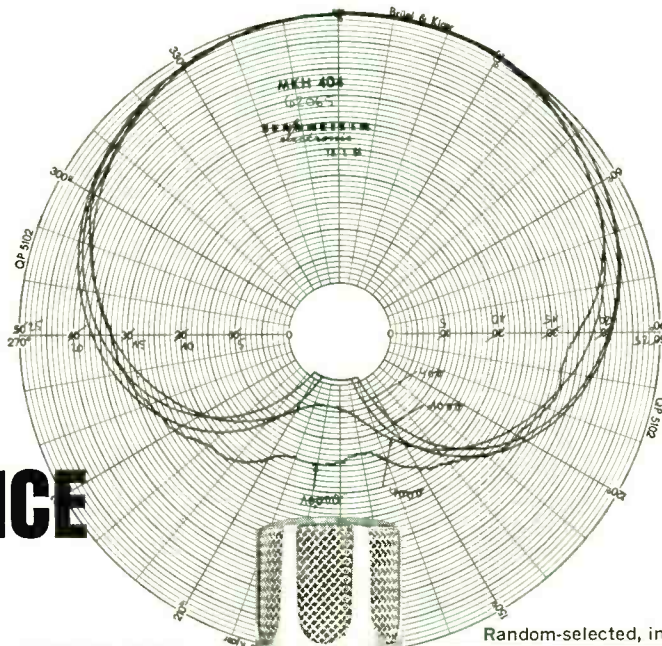
Eventually we overcame our alarm, and of course we were glad we did. Somehow, after we had put on the last coat of finish, and we stepped back in the time-honored fashion to view our handiwork, we knew that the result was worth it. It really exceeded our expectations. Considering our rank amateur standing (and ability) as a cabinetmaker, the cabinet shown in Fig. 7 is an almost impossible feat. That cabinet is as professional looking as any professional-looking cabinet.

The kit is delivered flat in a cardboard box about 6½-feet long (the 2600 series is 8-feet long) and it comes complete with everything needed to put it together and finish it. That includes giant wooden C-clamps, shims, nails, screws, stain, sandpaper, oil finish, and so on. Also they have developed a rather clever way of squaring the cabinet (a very vital procedure): One merely uses a pair of sharp-pointed sticks to measure the diagonals of one of the rectangular openings, and then adjust so that they are equal.

In spite of simple instructions we had great difficulty in hanging the center doors. In fact we never succeeded in doing it just right. Oh well, they're closed most of the time.

The cabinet could be put together in one sitting if it were not for the necessity to allow glue to dry—12 hours drying time for each major gluing. The finish is dark walnut, although it can be lighter if the stain is applied lightly or not at all (we discovered later). C-23

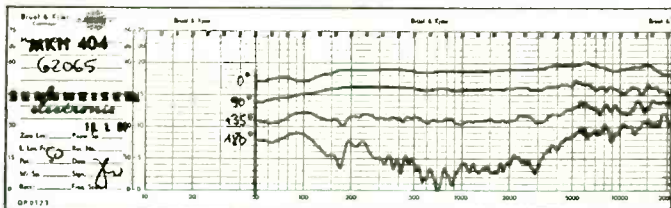
SENNHEISER PERFORMANCE HERE



Random-selected, individually drawn cardioid patterns, Type MKH 404

ACOUSTIC BARRIER TO THE REAR

THE FIRST CARDIOID CONDENSER MICROPHONE WITH TRANSISTORIZED RF CIRCUITRY.



Random-selected, individually drawn curves, Type MKH 404

Between the introduction of the MKH 104 Condenser Microphone into this country and its establishment as a standard of comparison, very little time has passed. Where the requirement for the most exacting professional performance can be met with an omnidirectional microphone, it is an unhesitating choice. Now with the development of the MKH 404, a comparable instrument is available when conditions dictate directional pickup. Thus, a significant milestone has been reached.

Cardioid condenser microphones are not new. But the MKH 404 is the first transistORIZED cardioid condenser microphone to employ integral RF circuitry successfully. This type of circuitry offers unique advantages in performance and convenience. It enables the exceptionally flat, peak-free response above and below the audio range; the minimal distortion; and the unusually low noise level. It also renders the microphone impervious to temperature changes, humidity, shock, and stray magnetic and electric fields. It eliminates the power-supply problem. The slender, lightweight assembly shown here in full size includes the plug-on power pack, which holds the 6 mercury cells that energize the circuit. The performance of the MKH 404 attests the success of the engineering effort.

The cardioid patterns and frequency response curves shown here, taken in the laboratory from a random-selected MKH 404,

MKH 404
(actual size)
Professional
Net \$230.

show the excellent front-to-back rejection ratio at all frequencies and the outstanding uniformity of response at any angle, as well as on axis. In fact, the directional characteristics are exact and independent of frequency. The individually graphed frequency response curve you receive with any MKH 404 will adhere very closely to the one shown here. Response below 40 cps has been tailored to meet practical requirements in most applications.

TECHNICAL DATA

Acoustic system	pressure-gradient responsive cardioid
Directional characteristic	cardioid
Frequency range	40 to 20,000 cps
No-load transmission	1.8 mv/microbar
co-efficient at 1000 cps	(corresponding to -35 dbv
(Sensitivity measured in	referred to 10 microbars)
anechoic chamber)	
Impedance	800 ohms, unbalanced, ungrounded (accessory cable transformer matches to 200 ohms)
Weighted noise voltage (German Engineering Standard DIN 45 405)	10 microvolts
Unweighted noise voltage	25 microvolts (peak-to-peak)
Distortion at 10 microbars	0.35%
Overload level	150 microbars
Power-supply voltage	8 volts \pm 1 volt
Operating current	approx. 5 ma
Temperature range	+14° to +158°F (-10° to +70°C)
Dimensions	3/4 in. diameter; 5 1/8 in. long
Weight	3 oz.

Battery Adapter
MZA 6
Professional
Net \$18.

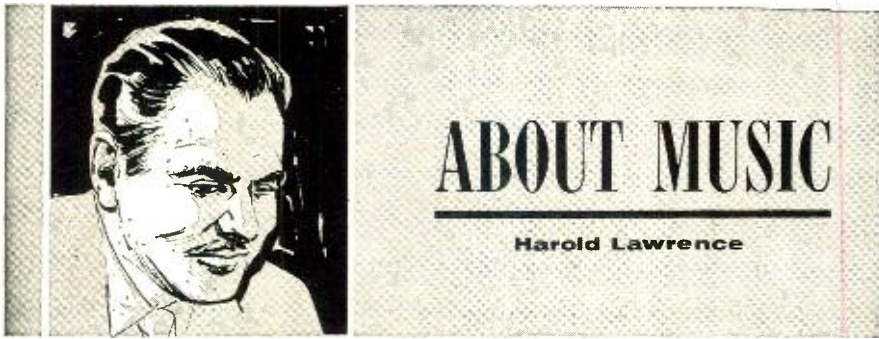


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Lighting In Our Concert Halls

UNTIL 1957, rehearsals of Broadway shows were held "on an empty stage lit by the one overhead third-degree light permitted by the electricians' union, a 500-watt bulb which makes the actor or dancer look like something in a badly kept morgue."

Most of our concert halls today bear more than a passing resemblance to the "glaring tomb" described above by Agnes de Mille in her book "And Promenade Home." Pale tuxedoed musicians perform against a white plaster background and beneath overhead strip lights—a sight familiar to all of us. To the few who believe a concert should be *seen* as well as heard, it is a disturbing sight.

"But concerts are for listening," the average music lover will say. "Give me enough light to find the way to my seat, read the program before the house lights dim, get an unobstructed view of the artist, and that's all I need." If his memory were jogged, the same concert-goer might recall the evenings he spent in the front rows of an auditorium when he was nearly blinded by the exposed proscenium lights, or the song recital he attended in which a spotlight with a bluish nimbus flickered over the squinting face of the soloist, or the

countless times the overhead lights produced shadowy figures who stared out at the audience through black sockets instead of eyes.

In fact, the more he thought about it, the more he would have to realize that the lighting of concerts was generally downright poor. The trouble is, he doesn't think about it. And this indifference, coupled with the lack of understanding on the part of architects and hall managers of the practical and esthetic functions of lighting, has resulted in the prevailing low standards of illumination systems in our concert halls.

At first glance, lighting a concert would seem an uncomplicated task. The basic requirements are to provide general illumination for the hall, bright lights for the stage, and special fixtures for the music stands. Beyond these primary considerations, however, the hall manager must decide, among other things, where to use direct or reflected lights, target or cross shots, horizontal beam spreads or overhead reflectors, back light, and, finally, how to regulate the luminous intensity of the hall and the stage to conform to the needs of a particular musical event.

Obviously this is no job for an

amateur. As an art and a scientific study, modern stage lighting is as old as the incandescent bulb, and the theatrical world has produced many distinguished designers. One of the most experienced is Abe Feder, who has been planning the lighting of theatres, concert halls, multi-purpose halls, and other public buildings for the past thirty years. Feder, who recently designed the lighting of the Place des Arts in Montreal, is constantly being struck by the widespread ignorance of even the most fundamental principles of lighting. Even in the latest constructions, lighting too often is an architect's afterthought. "In the final stages of the design," Feder said, "the builders will do little more than put a few holes in the ceiling and call it a day." A soft-spoken, articulate man in his early fifties, Feder is keenly aware of the special problems of lighting in concert halls. "Simply because the concert is primarily an auditory experience does not mean that the lighting of it is an insignificant job. It is terribly important to the enjoyment of the music. What ever else it offers, any event in which a performer appears on stage has to be regarded as a *visual* event; whether he is a speaker, a musician, or a priest, he must be seen comfortably by the audience. There must also be a pleasing counterpoint of background and performance areas, and the lights must never intrude.

"Take the question of darkening the auditorium during a performance," Feder continued, "At one time, there was no difference in luminous intensity between the stage and the auditorium. Today, the lighting for the audience ranges from complete darkness to near-brightness. But the right balance has to be struck between the two areas. Let's face it, when the audience is in a total blackout, some people are going to fall asleep. But if there's too much light, our attention, in visual terms, becomes diffused and a certain 'mystery' is lost."

In an ideal lighting system, the source of illumination is as discrete as a Rolls-Royce engine. Light is projected from recessed, shielded fixtures and never attacks the line of sight directly. Philharmonic Hall in Lincoln Center, which has its share of acoustical problems, also suffers from conspicuous multiple-light sources. Speaking of the hall's overhead fixtures, Feder said, "You can count 'em like soldiers, all those lamps pitching beams of light on the heads of the audience." Originally developed for General Electric by Feder, the reflector bulbs in Philharmonic Hall (Par #64 and #66) are used "raw" (without shielding) and produce a glaring effect. The situation has worsened during Phase 2 of the hall's tuning. In lowering the acoustical clouds over the stage area, the audience in the front part of the

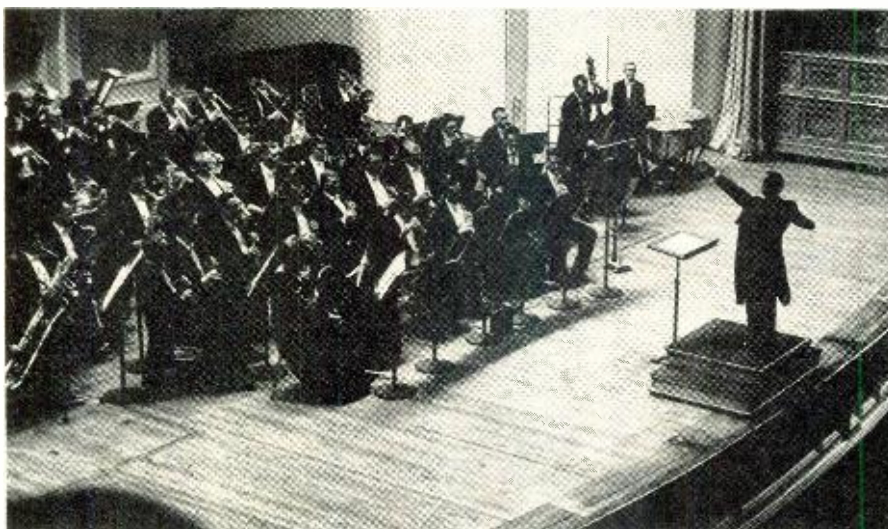


Fig. 1. Shadowy figures on the concert stage. (The Eastman Wind Ensemble at Carnegie Hall, Frederick Fennel, conducting.)

auditorium now find themselves looking directly into these target lights. Up in the terraces where the bulbs are hidden from view, the audience looks over the bulky mechanisms supporting the fixtures; the view resembles the behind-the-scenes of a giant television studio.

Turning to the stage, Feder played his searching light over the orchestral, part-reading musician. "The light fixture used on the music stands in most concert halls is primitive and inefficient. Not only that, it's distracting to the audience to see a score of tiny lights in the string section of an orchestra. To avoid this 'firefly' effect, the lights should target down on the music stands from invisible sources overhead."

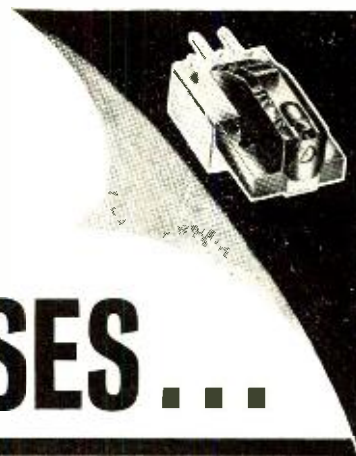
The target at a recent song recital in New York should have been the singer. Instead, the overhead beam engulfed the accompanist in a blazing circle of light, while the singer, outside the perimeter, was a mere silhouette against the shining ebony of the piano. It was a curious evening. One couldn't help being distracted by the expressive face of the pianist: his look of apprehension as the page turner fumbled his turn, his miming of a countermelody with knitted brow, and the darkening of his eyes as he approached a dramatic pianissimo passage.

Too much light plagued a trio playing in Carnegie Hall's Recital Hall this winter. No sooner had the pianist, cellist and violinist taken their seats on the stage than the electrician located in the mezzanine switched on a blinding spotlight. The chief victim was the cellist, who customarily turns slightly towards the audience. Frowning, he lowered his face while tuning his instrument. In the glaring light, several things were plain to see: the cellist was annoyed, the violinist needed a closer shave, and one could clearly spot the pianist's undergarments through her dress. During the intermission the cellist killed the spotlight and, for the rest of the program, the trio played in the atmospheric half-light provided by the rear fixtures.

In the design of new concert halls and in the renovation of the old, acoustics should certainly occupy first place. But, as Feder would put it, "Let's not just poke some holes in the ceiling and call it a lighting system." It is high time that the lighting of our music rooms be placed in the hands of competent imaginative lighting designers. ZE



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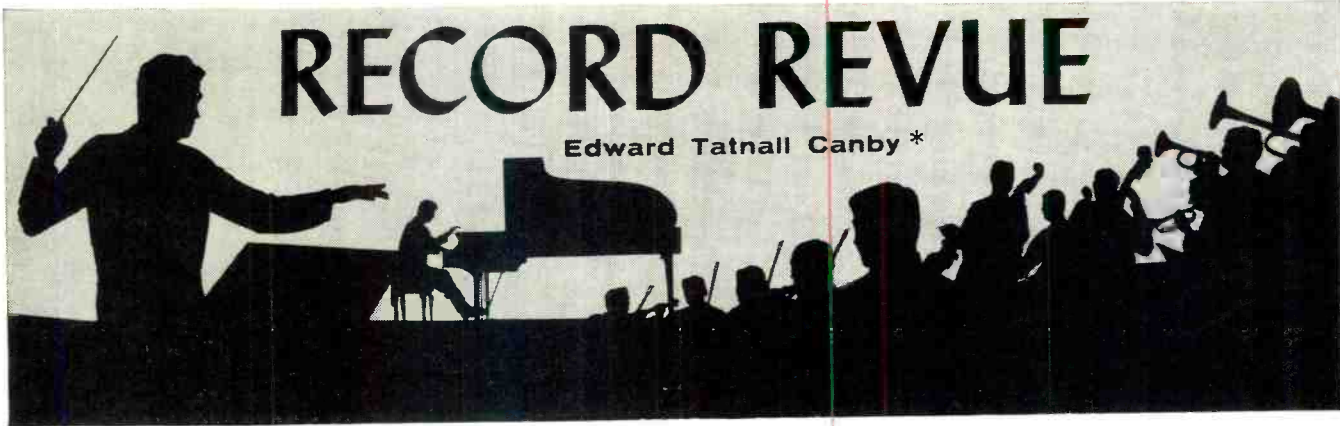
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RECORD REVUE

Edward Tatnall Canby *



That 4th Speed Again . . . "Extra Hours." Programmed Background Music (16 2/3 rpm).

XLP Record Corp. (stereo)
(415 Broad St., Lake Geneva, Wis.)

Here's the "world's first" programmed background music disc, 41 stereo selections and more than two hours' worth on a 12-inch LP. Coupla minutes was enough for my high-strung musical ear, but the technical problems remain interesting.

The sudden appearance of the Fourth Speed a few years back mystified many a home hi fi addict for there never has been much of anything to play on it. Talking books, poetry, non-commercial ventures, were the original idea. Vox once did put out a few mono LPs crammed with huge lengths of 16% music—big bargains if you didn't mind the quality. For the rest, I've always figured it was one-upmanship among changer makers that accounted for the continued 16 speed on home equipment, rather than any demand from listeners.

Well, this disc does prove that recent advances make it possible to cut a respectable 16% stereo groove within the well known generalities of "20-20,000", as here claimed. It also proves that the problem isn't in making the discs but in playing them. (This is a Cook Microfusion pressing, by the way, and no doubt was cut at ye Correct Angle and all the rest.) Yes, as I expected, the outer grooves produced pleasant musical sound, un-muffled and not too scratchy. But via a 1964 standard changer with .07 mil stylus and two or three grams pressure, the inner grooves sounded like mud, and that was that.

If you try an .05 stylus in a long arm, or maybe an oval (.03-.07) stylus in a shorter arm, you can probably release the full potential of these grooves right up to the center—and get that last hour or so of hi fi. The slow speed does have commercial possibilities in the background field, with the right playback equipment. But for the home user—no. Not until we are much further converted to the automated, totally un-manual disc and the super-miniaturized arm-and-cartridge. We probably never will be, unless with a whole new over-all system, new speed, shape, material and all. That now seems a distant prospect.

BIG MUSIC

Beethoven: Piano Sonatas in A, Op. 101; D, Op. 31, No. 2. Wilhelm Backhaus.
London C 6365 stereo

No need to note more than another appearance if one of the grand old men of the piano in the usual big, brilliantly massive London recorded piano sound. For anyone who tucks up to Beethoven, it's enough said, except maybe to add that this recent Backhaus seems to me better disciplined, more meticulous and

architectural beneath the typical Backhaus weighty drama, than his many earlier recordings. He's aging well.

Beethoven: String Quartet in B Flat, Op. 130. Budapest Quartet.
Columbia MS 6384 stereo

—And the same here—this continues the great re-recording of the late Beethoven quartets by the players who do them best of all, for this generation. I might note that in this long-drawn-out work the minor weaknesses of age, particularly in the first violin, seem somehow to be minimized, where in other recent Budapest recordings they have been occasionally well above threshold. A well-rested quartet at the recording session? Good weather instead of bad? No four-in-the-morning workouts? Could be.

Rubinstein. Mozart: Concerto No. 20 in D minor. Haydn: Andante and Variations in F Minor. Orch. conducted by Alfred Wallenstein.

RCA Victor LSC 2635 stereo

Here's another grand old man who has been aging very well. Rubinstein was once the prince of professional pounders, a big, flashy pianist who could play anything and did, with a certain "Look, Ma, no hands" attitude that merely stated the truth: he played the big stuff every day and he could play it in his sleep. Probably did.

Then, as age crept up, he began returning to the simpler and more profound things in music. His Brahms—the un-flashy late Brahms—was lovely. Beethoven, the architect, attracted him anew and successfully. Now he plays the famous D Minor Mozart piano concerto for the first time ever in public—after so many years! As he says himself, an old musician is inescapably drawn to Mozart, the ultimate.

Well, Rubinstein's several much earlier recordings of the A Major Mozart concerto were to me about as ugly as anything I knew—hard, show-off, unsubtle, patronizingly casual. Then, Mozart was child's play. So many pianists have made that dreadful mistake! Now, the big change. Indeed, I have heard better, more subtle Mozart than this recent recording shows: nevertheless, Rubinstein has gone fully 90% of the way from blatantly bad Mozart to very good Mozart. Only a few traces, in the loudest passages, remind us of the once hard-pounded ugliness—the rest is smooth as velvet, well phrased and, above all, thoughtfully, humbly played. Really something.

The long Haydn double-variations are impeccably played, too, but with a somewhat more old-fashioned miniaturist approach. The music is bigger, more Romantic, more serious than Rubinstein knows, even if it is "easy," and smallish in sound on the modern grand piano.

Rubinstein - Heifetz - Feuerman TRIOS. (Beethoven Op. 97: Brahms Op. 8; Schubert Op. 99.)

RCA Victor LM 7025 mono

Well, well, the Million Dollar Trio once again! Not so named, natch, by RCA Victor,

but well known under that title in musical circles. Here's RCA's best skip-wave technique—this is the third appearance of these recordings, if I'm right, including their original release in the days of the 78 rpm album.

I can't deny to RCA the praise due for such a reissue, even if I wish the company would do a bit more of an enterprising nature with today's recording. If you have a Past like this, you have every right and, indeed, every duty, to live in it, for profits. The recordings were stimulating in their day, not far from a quarter century ago; they were well worth reissuing when LP came in; and now they are still worth reissuing with improved quality, even without stereo enhancement. The three artists were humdinger solo showmen of their time and they still sound it. The music bristles with aliveness, scintillates with technique, soars with musical showmanship.

The only real problem with these performances was one that was built-in. Three great solo players tend, even in ensemble, to sound like three solo players. Not seriously—they were all much too good to kill the music off, along with each other. But the musical tension generated by the three of them is never altogether that of true ensemble music. It is always, and disquietingly so, that the tension which publicity so loves, the impact of several great personalities upon each other, all on-stage simultaneously.

It's not really overt, nor destructive of musical values, this extra-tension via celebrity-appeal. But the really musical listener will find that other more modestly endowed recordings produce better ensemble, and better Schubert, Beethoven, Brahms by a few hairs' width.

Brahms: Piano Quartet in F Minor, Op. 34. Leon Fleisher; Juilliard String Quartet.
Epic BC 1265 stereo

A splendid rendition of this rather passionate early work by Brahms, one of the staples of the Romantic literature and once ultra-familiar to music audiences—though no longer. It isn't easy to play with conviction, fullness and yet with adequate solidity, for it tends to wax over-emotional if allowed its head.

This is a good team for the music. The Juilliard players on their own tend to be cool and precise; big Leon Fleisher, an impeccable pianist, is also a powerful musical personality—he adds head and shoulders to the Juilliard body.

Interesting recording technique; for once, at last, the sound is really "chamber," i.e. rather dry and fairly intimate. That is as it should be. Too many small-force works of this sort are drowned in huge and inappropriate liveness merely because that's the style of today.

Brahms: Sonatas for Violin and Piano (No. 1 in G, "Rain Sonata"; No. 3 in D Minor.) Isaac Stern, Alexander Zakin.

Columbia MS 6522 stereo

Wonderful! It's about time this once-familiar recording team started production again. Don't know what happened, but I don't seem to remember anything from them since

the early days of mono LP. One of the best teams of the century.

The Isaac Stern violin sound in this recording is the biggest darned violin tone you'll ever hear on records, bar none. Enormous! A combination, I suppose, of a naturally big tone (from a fine fiddle) and a perfectly miked liveness, the mike at just that critical point where the reverberation somehow seems to triple the apparent loudness of the instrument. Too close, too far, and the effect is lost. The piano is a shade too much in the background by comparison—but only a shade. It's plenty audible.

Stern's playing is perfect for Brahms—broad, rich, full, yet absolutely accurate with never a trace of over-sticky sentiment, never a weakness of intonation or phrasing. Zakin's piano is a close match. Seldom has Brahms sounded so wonderfully rich and eloquent, never so un-dated, even though I have heard performances of greater subtlety, if perhaps of lesser sweep and power.

Rachmaninoff: Piano Concerti Nos. 1, 4.
Philippe Entremont; Phila. Orch. Or-
mandy.

Columbia MS 6517 stereo

This is a good deal more interesting than it might seem at first glance. First, the two concerti, the First and Fourth, are the ones that we don't usually hear—the intervening two are the standard fare. That betokens a more enterprising point of view on Columbia's part, and a livelier record, inevitably. War horses usually sound like war horses, which these aren't.

Second, there's Philippe Entremont, one of the finest, most casually excellent young pianists anywhere, a man with all the French graces of accuracy, good training, good taste, plus a fiery eloquence when he wants to put it on that lifts him well up on the virtuoso pedestal. And to back him up, the indefatigable Ormandy. Ormandy is the perfect ladies'-man conductor, who can make any old piece sound brilliantly if without real conviction. His talents, though, are just perfect for a suave, helpful, accurate accompaniment, with a real personality to do the honors in the foreground! He's good here, for that reason.

The Fourth Concerto, from 1927, was revised by Rachmaninoff as late as 1941 and so rates as from his very last period. The First, originally composed way back in 1891, was rewritten in 1917 during the Russian Revolution.

Bach: Suites Nos. 1 and 2. Orch. of the
Sarre, Ristenpart.

Counterpoint/Esoteric 5603 stereo

Though this comes from the Sarre and was originally released under French auspices (Club du Disque), the performance is in the German tradition—of today, that is. An odd combination of precise authenticity in some respects, such as accurate and correct ornaments in many of the melodies and a proper instrumentation, and a good deal of old-fashioned holdover Bach-style, notably in the slow introductory movements, which move with that pompous grandeur of rhythm, played literally as written, which is now generally known to be a misconception of performance practice in Bach's day. (The music should be faster, the dotted figures taken shorter.)

Still—one of the best recordings so far of the first two suites, and I particularly liked the flute solo in the second, which for once sounds musical and natural! Mostly, Bach's rather breathless flute part, with practically no pauses to replenish the lungs, is pushed by conductors and virtuoso flutists until you think the flute is going to pop a gut; here, the soloist plays at really reasonable tempi, the conductor gives him a chance to breathe naturally at the ends of phrases, and the result sounds human, not like an overworked steam whistle. Anonymous flutist, at that.

Everest (alias Counterpoint/Esoteric) is still putting its feet in its mouth. The notes on the back of this one are about the wrong suites, Nos. 2 and 3—the annotator blandly remarks that these are the "only two in the permanent repertory." Well, half of this re-

cord is given over to No. 1 even if the annotator doesn't think it's in the repertory! And I note some ten currently available recordings of *all four* of the suites, not including this set. *What* repertory, please, Mr. Annotator?

Bruckner: Symphony No. 7.
Wagner: Siegfried Idyll; Prelude to "Lo-
hengrin." Columbia Symphony, Bruno
Walter. **Columbia M2S 690 (2) stereo**

If you're ever going to like the monumental music of Bruckner, you'll like it here. Nobody can pull the vast mass together as did Bruno Walter, no one else could so beautifully calculate the tensions and lack of tension, the heart-throbs, the almost-pathos-but-not-quite, the near-repetitious near-rhetoric, so precisely for optimum usefulness. I came pretty close to enjoy Bruckner this time!

Yet nobody, I fear, will ever get me to worship him the way his devoted followers worship him. I like simple souls—Bruckner was a simple soul. But what of simple souls who aspire towards writing the biggest big pieces ever conceived of? Now if Bruckner had written really modest music . . . but this isn't. It may be sincere, filled with humble religious feeling and all the rest, but nobody can tell me it is modest! Even the humblest religious feeling sometimes manages to become overblown.

(Well, now I've damned myself forever, I suppose. If you feel like judging for yourself, try the three long sides of this symphony and test your own reactions.)

Haydn: Symphony No. 88 ("Military").
Columbia Symphony, Bruno Walter.
Columbia MS 6486 stereo

Another in the big posthumous Bruno Walter multiple release, this middle-late Haydn Symphony is played beautifully but in a mildly old-fashioned style, as was entirely natural for a conductor of Bruno Walter's vintage. That is, for those accustomed to the new "authentic" style of Haydn performance, the orchestra will sound rather too big here, the winds overborne by masses of strings, and the general tone will suggest at least a faint reminiscence of the "Papa Haydn" approach, that antiquarian detachment which a generation ago was universal wherever Haydn was played. After all, these performances seemed to say to us, Haydn was a pre-Romantic with a white wig and a pig-tail; we can't take him for real.

Bruno Walter was far too much of a musician to patronize Haydn in this fashion. Only the rather large "symphony orchestra" sound of this music puts him clearly back in his own generation.

Cliburn/Reiner. Beethoven: Concerto No.
4. Chicago Symphony.
RCA Victor LSC 2680 stereo

RCA Victor claims such ineffable greatness for so many of its performances that a self-respecting critic is practically forced into being critical! No—I wouldn't say this is the greatest Fourth Concerto on records and I wonder about all this vaunted "mystical quality compounded of intellect, emotion and spirit . . ." noted by Richard Mohr, who devotes most of his annotation on the jacket to this "great collaboration." Doesn't leave us fellows a positive word to say on our own.

But if you'll put aside all the above, I'll be happy to state that this is an excellent collaboration, in which the earnest young pianist, so pestered by too much publicity, has really worked hard on a modest but beautifully thought-through and consistent interpretation, devoid of flashiness and sensationalism. And for his part, old Fritz Reiner, who could be an obstinate musical mule or a conductorial pile driver when the mood suited him, does in fact turn in an orchestral performance as gentle as lambswool and just as cuddly. Clearly the two *did* get along well and the results were happy. If only RCA in its turn could put the whole thing equally modestly! A very nice record.

(Continued on page 74)

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- Sounds From Rikers Island, Elmo Hope Ensemble—AFLP 2119/AFSD 6119
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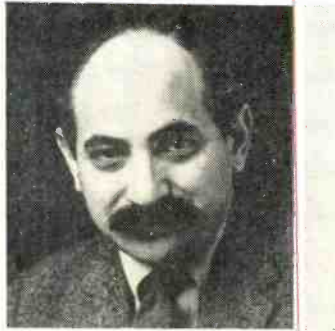
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JAZZ and all that

Bertram Stanleigh



Elmo Hope: Sounds from Riker's Island Audio Fidelity Stereo AFSD 6119

Riker's Island, located in New York's East River, is the site of a penal institution for drug addicts. Because our laws are designed to punish the narcotic user rather than to cure him of his habit, relatively few persons who succumb to drugs are able to break themselves of their addiction and return to useful places in our society. The present album is a welcome reminder that there are those who do manage to do so. All of its performers are jazzmen who were at one time inmates of Riker's Island or similar institutions, and this disc is a splendid demonstration that it is possible for a musician to emerge from such an experience with his technique and creative abilities undiminished.

A number of talents are exposed on this disc, chief among them those of Elmo Hope, pianist and the composer of six of the record's nine tunes, who reveals himself as a warmly elegant stylist with abundant dexterity and an inexhaustible fund of invention. Philly Joe Jones, drums, Lawrence Jackson, trumpet, John Gilmore, tenor, Freddie Douglas, alto, and Ronald Boykins, bass, comprise the balance of this experienced, well matched group. Each contributes valuable solo performances, most notable are those of Jones who also provides an exceptionally tasteful accompaniment on Hope's solo composition, *Kevin*. Two vocals are included: Earl Coleman on Ellington's *It Shouldn't Happen to a Dream* and Marcelle Daniels on Dizzy Gillespie's *Groovin' High*. Aside from a tendency for some of the percussion to divide into two

segments, one coming from the far left, the other from the far right, the sound is up to the usual Audio Fidelity standard which is about as good as can be expected at the present state of the recording art.

Jacques Loussier Trio: Play Bach Jazz, Vols. 2 & 3

London Stereo PS 288 & 289

On the heels of the great French recording of the Swingle Singers scat singing their way through the works of JSB, we have two more examples of French Bach in modern dress. (From the labelling, it is presumed that a Volume 1 was previously issued; however, it was not included for review.) These are instrumental recordings for piano, bass and drums, and while they occasionally stray from the text of the original scores, their fidelity to the spirit of the composer is remarkable, and the meaning of the music is projected with eloquence that is often missing from recitals of this music by classical performers. This is swing, rather than jazz, since there is not enough departure from the original music into free improvisation to qualify as jazz. However, the ornamentation employed is jazz-like and the performances are in the style of the best jazz trios. Jacques Loussier, pianist, is responsible for the arrangements, and he displays an impeccable keyboard technique in their execution. Pierre Michelot, the great French bassist, provides a splendidly matched counterpoint, fully integrated with Loussier's approach. Only

Folk Guitarron

Recently Vince Martin and Fred Neal got together for their first Elektra disc at Mastertone Recording Studios, just off Times Square in New York. When this reviewer arrived at the session, things were already in full swing. Paul Rothchild, Elektra's A & R Director, was in charge of the session, and Masterton's Gene Sayet was hard at work at the recording console. In addition to Martin and Neal, both of whom played guitar and sang, two accompanying instruments were used, mouth organ, played by John Sebastian, and *guitarron*, played by Felix Pappalardi.

U-47 microphones were used for the two voices, and 77b's were used for the instruments, a total of six microphones for four performers, since separate mikes were employed for voice and guitar. Everything was fed through the recording console and an EMT echo chamber into two Ampex 300's, one two-channel stereo, the other three-channel stereo. Elektra's President, Jac Holzman, explained that they normally use the two-channel tape as a master for both the stereo and mono discs. The three-channel tape is retained as a safety copy for use in the event that rebalancing is necessary. During recording a mix from the two-channel tape was used to monitor sound, and after each good take, a playback in stereo was checked.

In the field of folk music recording, no other company has such a long history of turning out records of consistent technical excellence as Elektra, and it soon became evident to me that one of the reasons for this high quality was careful attention to detail. An example of that detail is the remarkable balance between instruments and voices and the subtle relationship that has been achieved in the instrumental work between the two guitars

and the *guitarron*. (see Fig. 1). The employment of this rarely-used instrument makes possible a close knit, cohesive quality of plucked sound with a solid bass, a result not possible when the bass is supplied by a double bass. The double bass contributes low notes, but it is a slower, less responsive instrument whose overtones bear little resemblance to those of the guitar. In the hands of Felix Pappalardi, the *guitarron* sounds as rapid and flexible as a guitar. Its voice is lower, but it manages to articulate fast passages with none of the gutty overhang that invariably mars rapidly plucked passages on the bass, and this greater flexibility makes possible lively melodic interplay. A beautiful example of such interplay can be heard in an extended instrumental break during *Baby, Do You Hear*.

To the best of my knowledge, the present recording is the first disc of American folk music to employ the *guitarron* in its accompaniment. Heretofore its use has been limited to Mexican *mariachi* orchestras. But it can be anticipated that it will shortly find its way into a wide variety of folk and jazz performances now that



Fig. 1. Felix Pappalardi playing on the *guitarron*.

its merits have been so ably demonstrated.

Important as the accompaniment is to a folk recording, it must not interfere with the vocal portion of the record. The usual technique for avoiding such interference is to record the guitars off mike, but even then, with some of the small-voiced folk singers who employ loud, thumping guitar styles, the accompaniment often overpowers the voices. In this session, the use of separate mikes for voice and instrument resulted in a very happy balance that achieves crisp, bright presence from the accompaniment, together with sharply focused sound from the singers. And such clear sound is particularly valuable on the present set, since most of the songs are new and unfamiliar. No straining is necessary to catch all of the words, and much of the credit for this must go to the recording, since Martin and Neal do not employ that type of overly careful enunciation that makes each word stand out distinctly but robs the song of much of its meaning.

When I listened to a playback of the edited tape at Elektra's offices some weeks after the sessions, I was impressed by the strong mood of the music as it was projected by these two fine artists. Their deeply felt performances completely overshadowed all of the technical excellence of the sound. Particularly good was *Morning Dew*, a song about atomic fallout, and two solos by Vince Martin, *Toy Balloon* and *I'm a Drifter*. The first of these songs is a child's song, sung in a tender, wistful manner, the latter is given the lusty, vigorous approach it demands. By the time this article is in print, the finished record will be available, and I look forward to hearing it. Its title, "Tear Down the Walls," derives from another of the gems in this collection, a tune with a swinging rhythm and a fine mouth organ obbligato.

the drummer, Christian Garros, is occasionally too assertive. His employment of cymbals is a trifle energetic, especially in *Jesu, Joy of Man's Desiring*.

Volume 2 devotes one side to the *Partita No. 1 in B Flat* for keyboard, and the flip side contains a half dozen short pieces, among them the *Air* from the *Third Orchestral Suite* and the previously mentioned *Jesu, Joy of Man's Desiring*. Volume 3 includes the *Italian Concerto*, five of the *Two Part Inventions* and the *Fantasy in C Minor*, S. 906. While there is little novel about swing versions of classical music, performances as sensitive as these are most uncommon, and these discs are recommended for their value as musical experiences, rather than as mere curiosities.

**Mike Settle: Pastures of Plenty
Folk Sing Stereo 31002**

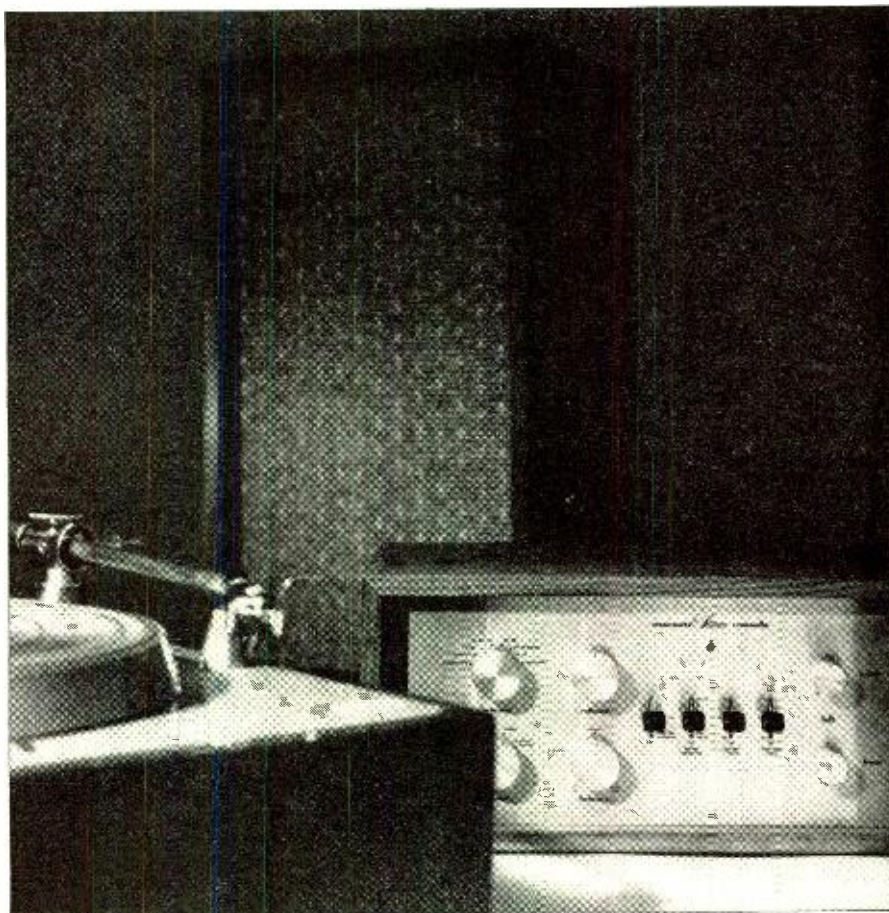
A fresh young voice with an agreeable Southwestern accent and an engagingly direct style are to the credit of Mike Settle. To his detriment must be noted a degree of detachment and indifference to the moods of the songs he sings. The outward manner is always correct, but throughout his recital one senses that conscious effect, rather than personal involvement, is at the focal point of his art. This is unfortunate because the musical talents of this young man are considerable. He is the master of a fine rhythmic style that makes it possible for him to spin out a long legato line without allowing it to drag or lose its contour, and he can alter the coloration of his voice to suit the special requirements of each of his songs. The deliberate quality in his singing is most apparent in humorous numbers, such as *Get up and Go* and *Masochistic Baby*. He is heard at his best on this record in *In the Hills of Shiloh*.

**Ace Cannon: The Moanin' Sax of Ace Cannon
Hi Records Stereo SHL 32014**

Altoist Ace Cannon is a robust musician with a healthy respect for the melodies he plays and a willingness to adapt his performing style to that of each piece as he encounters it, rather than force the music into the mold of his own personality. The result is some bright, highly successful, vigorously striding solo playing. However, Cannon has not been given instrumental backing suited to accent the rhythmic sophistication of his performances. Instead of the healthy competition of equals that his bold playing demands he has been coupled with a subdued, saccharine background consisting of an anonymous electronic organ and various chord pluckers all of whom have been artificially suppressed in an effort to keep Cannon in the spotlight.

**The Womenfolk—The Villagers: We Give a Hoot
RCA Victor Dynagroove Mono LPM 2821**

Recorded live at the Ice House in Pasadena, California, this disc features all of those painful extras that one has become inured to on recordings made in the presence of live audiences: spoken introductions, jokes, applause at the end of selections and sometimes during numbers, and miscellaneous audience noises that force performers to sing at higher levels than their voices are capable of coping with. In the words of the liner notes, "Here is a hootenanny in the shoutinest, singin-est, foot stompin-est sense of the word by two fantastically talented groups you're going to hear more of." If this disc is in any sense a token of what we are likely to hear from these two groups in the future, these words take on the aspect of a threat rather than a prophecy. Two such untalented agglomerations have rarely managed to worm their way onto microgroove, and the poor balance achieved in recording between voices, instruments and audience sounds does much to obscure any of the finer details that may possibly have been present in the live performances.



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Mark IV with dual diamond styli, \$24.25*; with diamond/sapphire, \$20.25*. Hear the new Velocitone Mark IV at your hi-fi dealer. *SUGGESTED LIST

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The Tape Guide

HERMAN BURSTEIN*

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

Following is a reader comment on the "mismatch" question in the February 1964 installment of the Tape Guide. ("When I play my tape recorder from the tape head output into the tape head input of my receiver, I have to turn the volume all the way up, and hum occurs.")

Robert McNeill, Music Department, New York University, 24 Waverly Place, New York City, writes:

"The problem with volume is most likely the difference in output between the tape head and the phono cartridge. We are running a stereo playback head into a pre-amplifier and find the approximately 2-mv output of the head far less than the 10-mv or so from most phono cartridges when playing the usual run of records. The hum is probably due to poor grounding of the tape transport frame. We are still sweating this one out, trying first one grounding arrangement and then another, in an effort to get a reasonable noise ratio. Judiciously applied earth grounds seem to have the best results."

Following is a reader comment on the "monophonic difficulty" question in the February 1964 issue of the Tape Guide. (The reader wants to record 4 tracks monophonically, but always hears Track 1.)

Donald M. Goss, 1648 W. 9th St., Brooklyn 23, N. Y. writes:

"I know exactly what the man has to do if he owns a Viking machine. Starting with a virgin reel of tape, with the machine in stereo record, record on Channel 2. Make one pass on the reel, turn it over, and continue recording, using Channel 2 only. Viking machines have a mono-stereo switch. Put this switch in mono position. This makes Channel 2 inoperative. Record on Channel 1, making one pass with the reel turning it over, and completing the reel. In playback, the selector switch is put in Channel 1 or 2, where either channel is put through both power sections to the speakers. This works, with crosstalk being about 35- to 40-db down. When recording on a previously recorded tape, the record switch has to be put in the sound-on-sound position to make the Channel 1 erase head inoperative."

Tape Hiss

Q. I recently traded a tape recorder of 1958 vintage for a newer and somewhat more expensive machine. The improvement in the quality of the tapes that I have made since this purchase is an indication of the rapid advancement in the quality of audio

components. I do have one reservation about tape, though. This is the prominence of hiss, especially with low-speed equalization (3.75 ips), even in a machine with as low a noise level as my present one. Since the resistors used in this machine are not of the low-noise type I suspect that an improvement can be had. The circuitry of the preamplifiers is transistorized, and in this type of circuit I have no idea where such changes should be made. Also, I do not know whether or not the first-stage transistors add an appreciable amount of noise. If they are a significant factor, I should like to replace them. Is such replacement possible for the 2N407 used in this circuit? As is usual, the majority of the noise appears to originate in the playback circuitry, especially when the low-level stages of the record amp are not in use. Would there, however, be a great enough improvement in performance to warrant making changes in the record amps? If it is possible for me to achieve a signal-to-noise improvement of 3 db or more at 3.75 ips, I would probably do the bulk of my recording at this speed. The economy of this speed is tempting, the frequency response of the machine is heartening, but the noise is prohibitive.

A. I have checked with the manufacturer of your tape recorder, who states that the 2N407's are specially-selected units for low noise and other desired characteristics. However, quality control is not perfect in any firm, and there is the further possibility that transistors originally good may have changed with use. Hence you *might* obtain an improvement by using new transistors in the first playback stage. The manufacturer stated that he could not suggest an alternate type of transistor that you may substitute, for the 2N407 (in the way that you may substitute, say, an ECC83 for a 12AX7).

It doesn't seem likely that you will get a significant improvement from low-noise resistors, because the dominant noise is from the transistors. However, there is little harm in trying low-noise resistors in the first stage or two; I say little rather than no harm because I understand that low-noise resistors are sometimes more vulnerable to current surges than are the garden variety resistors.

Under-recording may be responsible for excessive noise. If your record-level indicator is not properly calibrated, you may be recording at too low a level, which of course accentuates the ratio between noise and the desired audio signal. You may be accentuating noise in the stages after the playback preamp's gain control; that is, you may have this control at a relatively low setting, compensated by a relatively high setting of the gain control in your external audio system. A better situation would be to have the tape preamp control set high and the audio system's control low.

The physics of tape recording result in greater noise at 3.75 ips than at 7.5 ips because of the greater amount of treble boost in recording and the smaller amount of treble cut in playback at the slower speed. To illustrate, a typical high quality home tape recorder at 10,000 cps supplies about 16 db of record treble boost (referred to 1000 cps) at 3.75 ips, compared with only 10-db boost at 7.5 ips. In playback, this machine attenuates 10,000 cps by 6 db at 7.5 ips, and by 0 db at 3.75 ips.

Separate Preamps?

Q. Is it axiomatic that a machine with 3 heads (separate record and playback heads) will have separate record and playback preamps and thereby permit monitoring off the tape?

A. In practice, nearly all machines with 3 heads do incorporate separate record and playback electronics and thereby permit simultaneous recording and playback. However, there is at least one machine on the market with separate record and playback heads that uses a single tape electronics for both modes of operation; obviously, monitoring off the tape is impossible with this machine. The advantage of having separate record and playback heads in this case lies in the fact that each can be designed for optimum operation. A head designed for both recording and playback entails some sacrifices in performance.

High-Frequency Danger

Mr. Barnhouse, 517 W. 18th St., Los Angeles 15, California, brings to our attention some cautionary remarks by Electro-Voice about the dangers that a tape recorder may present to a tweeter: "If the speed of a tape machine is advanced beyond the normal speed, high frequency power is increased at the rate of 6-db per octave over normal for each doubling of tape speed. In fast forward or rewind, supersonic energy of great magnitude may be generated, even though the head gate is open. Always reduce volume during this process even though the signal is inaudible. This is especially important in fast editing procedures, where the gate is frequently only partially opened so that the tape traverse can be cued audibly."

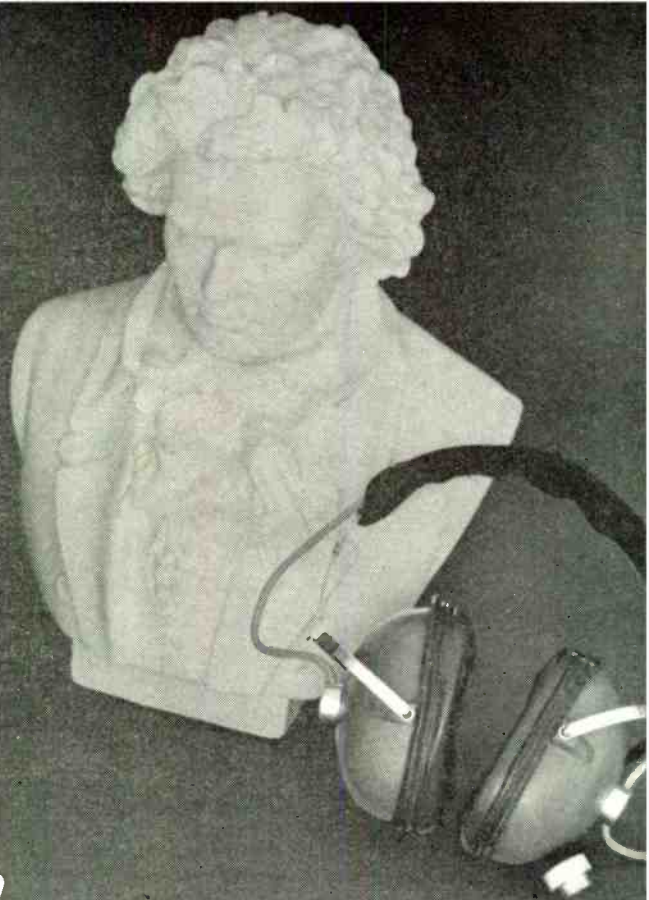
Automatic Shutoff

Q. I own a tape recorder, which is a fine instrument and has given me much pleasure. It has one disadvantage as compared with other recorders in its price range: it has no automatic shutoff device. This is practically a must if you wish to leave the recorder unattended. Are there any such devices presently marketed which could be employed on my machine? If not, do you know of any literature covering the subject and describing a homemade installation?

A. I do not know of any separately sold automatic shutoff device for tape recorders. However, if you are mechanically inclined, you might inspect the automatic shutoff provision on various tape machines to see if you can copy the method employed by one of them. One of the simplest, I believe, is that of the Tandberg. A wire finger connects to a sensitive microswitch, which in turn controls the machine's single motor. When the tape is inserted in the loading slot, it moves the finger forward, enough to put the microswitch into the on position. Where there is no tape in the loading slot, the finger springs back to the off position.

Æ

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



collector's item



The Concord 884 transistorized stereo tape recorder is designed for the connoisseur of sound, the collector with tastes and demands above the ordinary. No other recorder, regardless of cost, has all the Concord 884 professional quality features.

Three separate heads—one record, one playback and one erase—assure professional quality reproduction from FM multiplexing, stereo records and live performances. Four completely separate preamps—two record and two playback—and full transistorization assure maximum reliability. A flip of the AB monitor switch lets you compare source vs. tape while recording.

A few of the other features are: built-in sound-on-sound switch for effects such as electronic echo chamber; stereo headphones output; automatic reel-end shutoff; 3 speeds; 2 lighted VU meters. All push-button operation; 15 watt stereo power amplifier and separate 7" full range speakers complete your 884 stereo system. Model 884 under \$450.* Other models from \$100.*

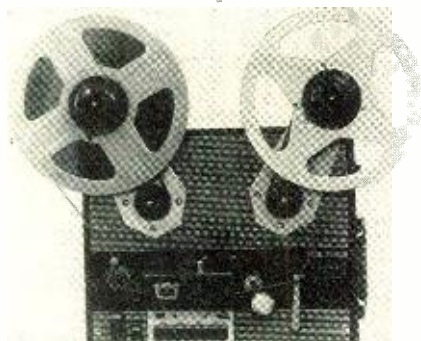
*Prices slightly higher in Canada.

For Connoisseurs Of Sound

CONCORD 884

NEW PRODUCTS

● **10½-in. Reel Adapter.** The new Roberts 10½-in. reel adapter for the Model 455 tape recorder was introduced to expand the professional versatility of the machine. The new adapter accepts both NAB and standard reel hubs and doubles recording and uninterrupted playback time while reducing distortion to absolute minimum.



The company also noted the availability of 15-ips kits for the Model 455. The adapter may be installed by the owner in minutes. Other accessories in the Roberts line include stereo headset, ceramic microphone, matching stereo speaker system, bulk tape eraser, and tape head demagnetizer. Roberts Electronics, 5922 Bowcroft Ave., Los Angeles 16, Calif. **C-1**

● **New Line of Components.** Introduced at the Los Angeles Hi-Fi Show will be the Kenwood Models KW-70, KW-200-A, and KW-100-T. The KW-70 AM-FM stereo receiver receives AM-FM stereo broadcasts, plays stereo and mono records, both tape and disc. The KW-70 features advanced multiplex circuitry with high sensitivity. This 65-watt provides 32.5



watts in each stereo channel with a harmonic distortion of only 1 per cent. It is priced to retail at \$269.95. The Kenwood Model KW-200-A amplifier is priced to retail at \$139.95 and the KW-100-T AM-FM stereo multiplex tuner is priced to retail at \$129.95. Kenwood Electronics Inc., Los Angeles, Calif. **C-2**

● **80-Watt Tuner-Amplifier.** A new transistor FM-stereo 80-watt combination tuner-amplifier, designated the "Imperial 1000" has just been unveiled by Bell Sound. This is the first of a new series of transistor stereo components supplementing their present line of tube-type tuners,



amplifiers, tape decks, and tape recorders. The "Imperial 1000" features an 80-watt stereo amplifier with a frequency range from 9 cps to 85 kc, I. M. distortion less than 0.7 per cent, harmonic distortion less than 0.25 per cent. Tuner sensitivity

is 0.48 microvolts at 75 ohms. Bell claims outstanding tuner sensitivity and distortion characteristics resulting from the silver-plated chassis, four-gang tuner, special "harmonic-cancelling" balanced detector design, special limiters, and the use of four Nuvistors in the r.f. section.

A "first" claimed by Bell is the modular concept applied to this type of product which permits the tuner, which is a completely plug-in assembly, to be removed at any time without affecting the amplifier operation. Users may purchase the amplifier portion initially and add the tuner section at a later date, if desired. The Imperial 1000 is priced at \$529.95, consumer net and an optional walnut enclosure is available at \$29.95. Bell Sound, Columbus, Ohio. **C-3**

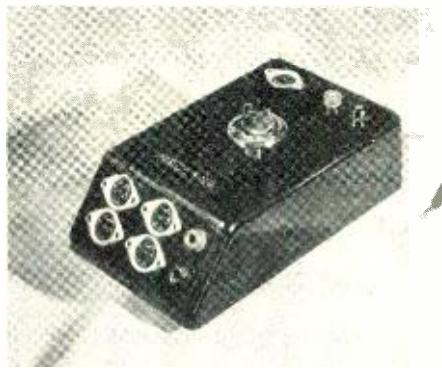
● **Medium-Price Recorder.** Concertone has announced entry into the medium-price stereo tape recorder field with the addition of the Model 801 to their line of tape recorders. The new Model 801 incorporates Concertone's famous "Reverse-O-Matic" feature, which is now engineered to record as well as play back in both directions. A three-motor tape transport system provides automatic two-direction record and play through the use of six heads, three



for each direction, and utilizes a symmetric center capstan drive. The Model 801 also features solid-state record and playback preamplifiers, and in addition has pushbutton operation with optional remote control. Retailing at \$399.95, the 801 has a handsomely-styled portable carrying case with built-in stereo speaker-amplifier and includes two microphones and reels. Also available for custom installations is the Model 802, retailing at \$349.95, which is the same as the Model 801 less portable case and speaker-amplifier system. Concertone, Culver City, Calif. **C-4**

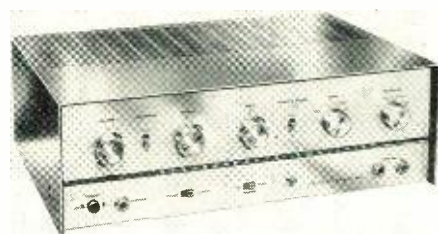
● **Microphone Demonstrator.** The Model P75 Sound Probe offered by Beyer is an instrument designed to test the performance of all types of microphones and headphones. It is a battery operated, completely portable, four-stage transistorized amplifier with gain control, four Hirschman sockets wired for various inputs and one for output, as well as two sets of banana jacks, one for input and one for output. Input impedances accommodated range from less than 1000 ohms up to 1 megohm for phono pickups. Output impedance is 10 ohms, designed to feed a maximum of 400 mv into a 10-

ohm load or 700 mv into a 200-ohm load. Maximum gain is such that an input of less than 0.1 mv will give rated output. Frequency response is within ± 2 db from 50 to over 100 kc at maximum setting of the gain control, and to cover 25 kc at mid settings.



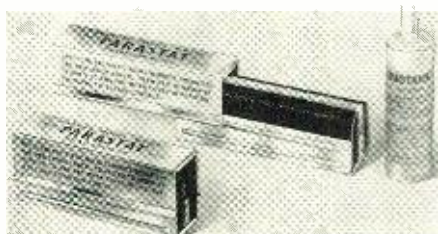
The unit is powered by six 1½-volt penlite cells, which will provide 100 hours continuous use or over 6 months intermittent use. The amplifier is designed to feed Beyer DT48, DT90, and DT95 headphones, but any other phones of suitable impedance—or a meter—may be used on the output. Among its uses are determinations of microphone polar patterns, locating proper microphone position for sound reinforcement, and general use where a high-gain portable instrument is required. Rye Sound, Mamaroneck, N. Y. **C-5**

● **40-Watt Stereo Amplifier.** Lafayette announces a new 40-watt integrated stereo amplifier. The model LA-260 is priced at \$79.95 with case. Control facilities include concentric bass, treble, and volume controls; low-cut rumble filter; selector switch gives choice of phono, tuner, tape



head and auxiliary program sources; mode switch; speaker-headphone switch; and a phase switch. In addition tape recorder outputs are provided on both front and rear panels. Tape head inputs permit direct playback from recorder tape heads. Lafayette Radio Electronics, Syosset, L. I., N. Y. **C-6**

● **Record Cleaner.** Designed to bring old records back and protect new records, the manual "PARASTAT," invented by Cecil E. Watts, noted record-care expert, features bristles and detergent which



reach deep into the grooves, removing accumulated dust, grit and residue. It acts as a "Preener" and a cleaner. The brush is made of nylon bristle. Price is \$15.00. Elpa Marketing Industries, Inc., New Hyde Park, N. Y. **C-7**

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the best PERFORMANCE_____ Music comes alive with a McIntosh. You hear all there is to hear. Nothing is added or subtracted. Each instrument is recreated. This is possible because of low distortion in all McIntosh instruments. Now you and your family can enjoy your music system without becoming dissatisfied.

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● **Tape and Accessories for 5-inch Reels.** The 3M Company, manufacturers of "Scotch" brand sound recording tapes, is now providing an increased amount of tape footage on a 5-inch reel, and also is offering a self-threading reel as an acces-



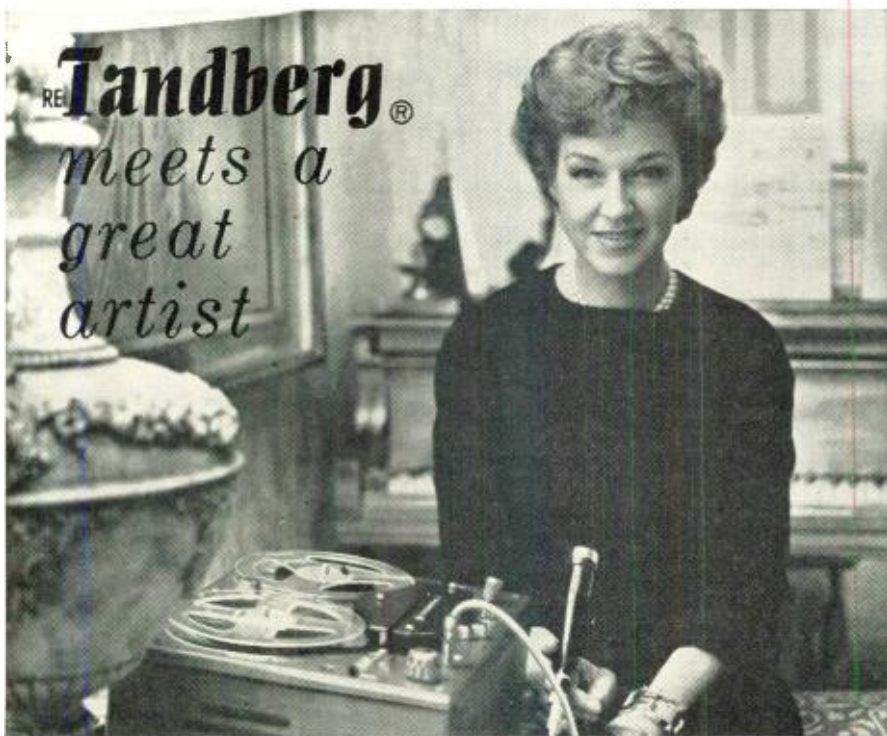
sory. "Scotch" brand No. 290, a triple-length sound recording tape, now comes in 1800-foot lengths on 5-inch reels. The triple-length tape is already available in 600-foot lengths on 3 1/4-inch reels for transistor recorders and in 3600-foot lengths on 7-inch reels. The 1800-foot tape will provide up to three hours of recording at the 3 3/4 ips speed or half that at 7 1/2 ips. The additional playing time was made possible by use of 1/2-mil tensilized polyester base. It is splice-free and treated with 3M's silicone lubricant which reduces recorder head wear. List price of the new tape is \$6.95 per roll. 3M's new self-threading reel is threaded by laying the tape between the flanges near the hub, eliminating fumbling with slots or hooks. As the reel spins, the tape winds automatically around the hub. In addition, tapes unwind freely and easily off the reel. A collar snaps tight to protect the tape from dust and damage. At \$1.50

list price, each reel includes write-on labels for both reel and collar. 3M Company, St. Paul, Minnesota. **C-8**

● **Stereo Tape Deck.** The new EICO Model 2400 tape deck is a compact 4-track stereo and mono recorder-player incorporating a 3-motor tape transport with electrodynamic braking. Record and playback equalization are provided at both 7 1/2 and 3 3/4 ips tape speeds. Mixing, microphone, and line-level controls are provided as well as "eye tube" level indicators. No pressure pads are used. Wow and flutter is less



than 0.02 per cent at 7 1/2 ips and 0.03 per cent at 3 3/4 ips. Other features are a top-of-deck jam-proof speed shift; digital turns counter; and automatic end-of-tape stop switch. Price \$269.95 wired, \$189.95 kit. EICO Electronic Instrument Co. Inc., 131-01 39 Ave., Flushing, N. Y. **C-9**



RISÉ STEVENS

Applauds the "Better, Clearer, More Natural Recording Quality" of **Tandberg**.

Model 74 $\frac{3 \text{ speed}}{4 \text{ track}}$

Complete Stereo Music System

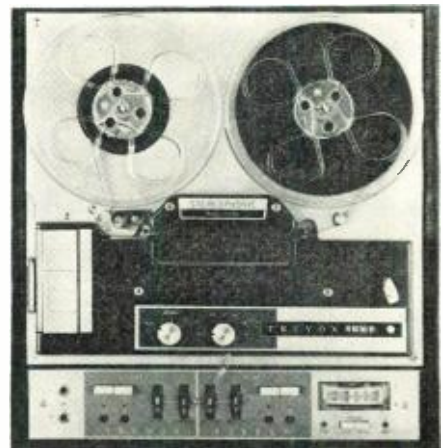
The sheer brilliance of recording quality . . . from any source, is one of many reasons why the celebrated Miss Stevens favors Tandberg. Add to this the clean, crisp playback and such features as: FM Multiplex Filter, new pause control, "free" position tape threading, precision laminated heads, 4 pole asynchronous motor, lowest tape tension, and a virtual lack of wow and flutter. You, too, will then discover why Tandberg is rated the number 1 quality choice by everyone.

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

● **3-Head Stereo Tape Deck.** A 4-track stereophonic tape deck that is claimed to offer more professional features than any other in its price range has been introduced by Benjamin Electronic Sound Corp. Known as the Benjamin-Truvox PD-100, the unit features three heads for recording, erasing, and playback; separate built-in preamplifiers for recording, playback, and direct off-the-tape monitoring; three motors, one for each reel, plus a Papst motor for driving the capstan; three speeds (7 1/2, 3 3/4, and 1 1/2 ips); and two independent VU record-level meters, one for each channel.



The Benjamin-Truvox PD-100 features accurate editing and cueing. Tape is instantly stopped or started by a convenient "Cue" button; the complement of heads is protected by a hinged cover which also provides access to the tape for editing, as well as for easily cleaning and servicing the heads. A special splicing guide-plate is built into the head cover itself. The machine is shut off when the tape runs out or breaks. Manufactured in Great Britain, the Benjamin-Truvox PD-100 is extremely compact and retails for \$399.50, less base. Benjamin Electronic Sound Corp., Westbury, L. I. **C-10**

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by Edgar Villchur

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A TRANSISTOR FM SQUELCH

(from page 21)

such as the 2N657 or the 2N699 could be used.

R_4 is selected so that there is 2 ma or so of current through CR_3 with no signal.

When the limiter is turned on or cut off, a step-function is introduced into the audio output, causing a thump-like sound. To minimize this, circuit action is slowed up at both turn-on and turn-off of the limiter screen. At turn-on, the screen divider charges C_2 through R_4 and CR_2 . Under normal operation R_5 does not function. At turn-off, C_2 is discharged through R_5 because CR_2 is reverse biased. If the tuning response is too slow, C_2 should be decreased. The value used seems to be a good value for today's high tuning-ratio dials.

A bistable device such as the Schmitt trigger in place of the Darlington pair would yield slightly improved performance. The audio is either on or off. Without complex circuitry, the turn-on and turn-off points are widely separated, causing low level signals to be squelched out.

Installation

Since there are only a few parts added, there should be no particular mounting problem. No heat sinking is required for the 2N697's because they can safely dissipate 0.6 watts at a 25-deg. case ambient. The dissipation for the transistor pair never exceeds 0.1 watt. Mounting of the transistors on top of the chassis away from high temperature components is suggested. Remember that the transistor case is internally connected to the collector.

C_3 and C_4 should be mounted close to their associated tubes. Other than that, the remaining parts layout is not critical.

R_3 in the author's tuner is a screw-driver-adjusted unit mounted on the rear of the chassis. A defeat switch is mounted on the front panel.

Performance

The present circuitry has remained unchanged for more than a year. During that time no readjustment of R_3 has been necessary. As with afe, the squelch is defeated when tuning extremely weak stations. But most of the time the squelch is left on.



ALTEC SOUND TALK

WHY YOU PAY MORE FOR THE ENDURING QUALITY OF ALTEC PLAYBACK COMPONENTS

From time to time, we are asked why Altec PLAYBACK Components can't be made to sell for less, so that the quality of PLAYBACK could be enjoyed by more people. Our reply—one that we give quite sincerely—is: How can anyone claiming to offer the quality of PLAYBACK Components sell for any less when all manufacturers pay exactly the same for labor and parts (such as resistors, transistors, capacitors, transformers, tubes, and so on) assuming these parts are of identical quality to the ones we use. Naturally, anyone can sell for less by using fewer components, and cheaper components, and less care in manufacture. It is always possible to make a product much cheaper and a lot worse. But where is the "bargain?" After all, you buy components to obtain the finest sound reproduction available. To settle for less . . . to purchase components on the basis of price alone . . . means that you have settled for second best.

HOW TO DETERMINE WHICH COMPONENTS ARE RIGHT AT THE PRICE:

The logical answer: Buy the same components the professionals buy and use—the broadcast technicians, the recording artists and engineers, the musical conductors—the people whose bread and butter depend on the selection and use of the finest sound systems it is possible to obtain. You will find that Altec PLAYBACK Components are used as standard studio equipment at ABC, Capitol Records, Columbia, Sam Goldwyn, Glen Glenn, Studio 3, Walton and many other broadcast/recording studios of equal technical excellence. These, and many other big name users, are shown in our illustrated brochure, "Altec PLAYBACK Equipment" (We would be happy to send you a copy.) Going back 40 years to Western Electric Company, Altec engineering has been foremost in the broadcast and recording arts and it is this experience that is available to you through Altec PLAYBACK Components.

PREMIUM QUALITY COMMANDS PREMIUM PRICE

Altec PLAYBACK Components cost more than ordinary "hi fi" because equipment that is built to professional standards, for use by professionals, simply can't be built for any less. Your home music center may well be one of the largest single equipment investments you will ever make. And, since you're buying for the years ahead . . . for the ultimate in musical enjoyment . . . in the expectation of always hearing the best that music reproduction has to offer . . . may we suggest that you emulate the professionals in selecting your components? Insist on listening to genuine Altec PLAYBACK Components in a direct comparison with any other units, of any make. Then, see if you don't agree that "the price for the very best is always right . . ."

Altec Lansing Corporation
Anaheim, California

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MUSIC FESTIVAL

(from page 20)

dividual solos, ensembles, concerts or portions of concerts, at the request of the various guest artists so that they could critically analyze their particular parts. This finished, the Lo-print master tapes were then marked, timed, and stored for possible playback to the chorus and orchestra at some future date prior to the next Festival. The Festival program was marked with the gain settings, microphone locations, timing, and other information and filed with the others in a three-ring binder.

Let it be understood, that we do not attempt to record for the same effect as a professional recording crew. Our tapes are made for the purposes of constructive criticism. Permission to record must come from the Musicians' Union and any restrictions the Union imposes are strictly followed. We have no control over the location of soloists, or the acoustics of the auditoriums, nor do we have the money or the time to revamp them. We never ride the master gain because these people who come here to teach and to be taught have very excellent hearing and are apt to become disappointed when discovering the beautiful pianissimos they so valiantly struggled to obtain, was boosted 5-db

or so by the recording engineer or audio mixmaster (and we don't blame them). Up to the time of the 1962 concert, entrance to the West High School Auditorium and the locations for hanging the microphones, were the whim of the auditorium custodian; however, this year we were very fortunate in having a new custodian who is a recording enthusiast himself. We get only one shot at a concert, one simple goof (such as forgetting to turn the recorder on) results in one "shot" concert.

Each year the Festival programs some masterwork for the main and final concert. In the past, we have had such works as the Mozart "Requiem," Verdi "Requiem," Beethoven "Missa Solemnis," Bach "Passion of St. John," and so on. The other concerts during the Festival may be all orchestral or perhaps orchestra with soloist or chorus.

This year (1963) the Main concert was the Bach "B-Minor Mass," a work which really separates the little boys and girls from the SATB's (Soprano-Alto-Tenor-Basses).

Here in Anchorage, most of these lovely people (Orchestra and Chorus members) either have hi-fi sets or have plans on future purchases of same; some teach and direct music in schools, colleges, and church choirs, and choruses and even record their own sessions for critical analysis. The recorder is a very

useful tool particularly if one is community minded, and along the same line of thought, an understanding wife is a necessity. Mrs. M. Kirschbaum is one of the boosters for the Orchestra, and my wife sings in our church choir.

One small item in closing: We believe more details involving the recordings by companies could be included on the reverse side of the record jackets—such as the name or names of the recording engineer and crew, the hall, microphones, the assistant conductor, any outstanding solo instruments, and so on. Some record companies do, more should. Sometimes just a picture of the orchestra on the front jacket showing the hall and the microphones can save the reverse-side space for advertising. There must be thousands of amateur recorders recording for their respective churches, choirs, or orchestras who, like myself, digest this magazine page by page, gleaning every juicy recording and audio tip possible for local application. This has been an insight into Amateur Recording in the Greater Anchorage Area, and I hope some bright young genius will write an article containing the many items I have yet to encounter.

(An aside: Eight years ago, knowing nothing about "Hi-Fi," I curiously picked up my first copy of AUDIO at the newsstand—that was the most expensive magazine I ever purchased.) Æ



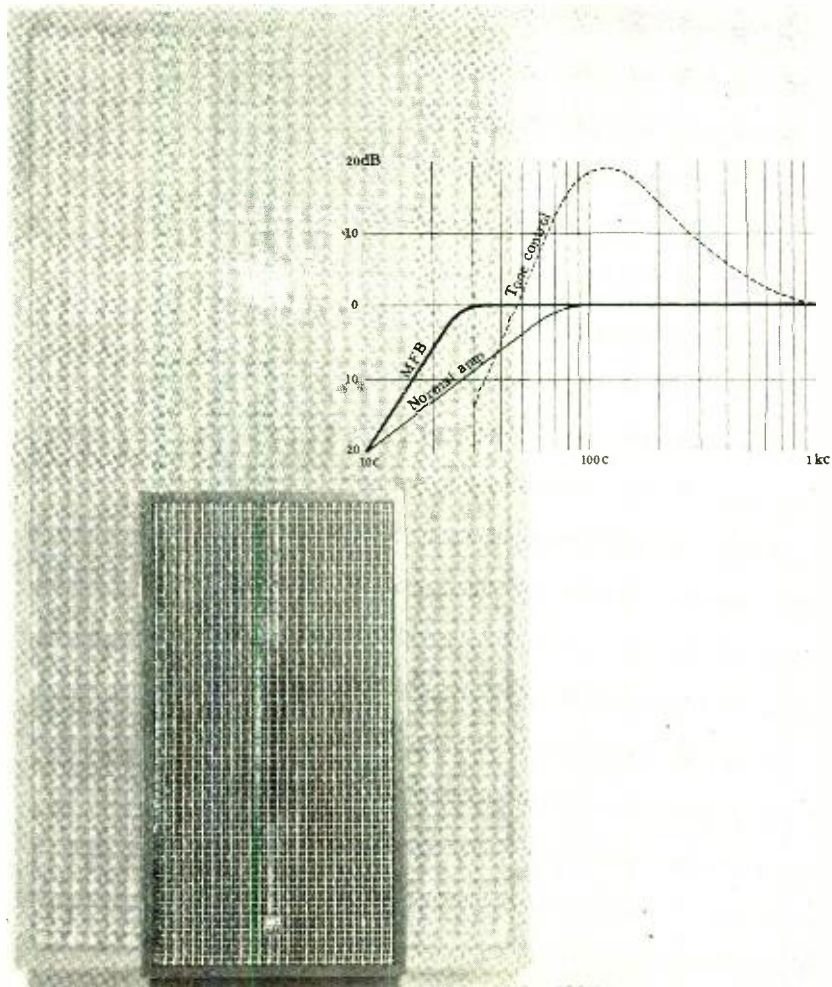
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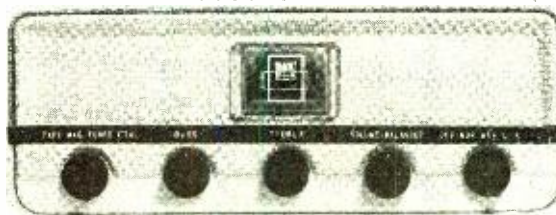
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LUX CORPORATION Osaka, Japan

TUNING ORGANS

(from page 24)

of accuracy compatible with the rest of the system. As a system, calibrated fork, tuner, and oscilloscope assure accurate tuning of an organ "A" to 440 cps and, subsequently, all tones of the reference octave.

After the organ "A" has been tuned to the fork frequency, subsequent re-settings of the tuner range knob are not referenced to the fork, but to the organ "A." This procedure is emphasized in all three parts of the series, and provides the most accurate tuning. In addition, it is particularly helpful when a pipe organ is gradually shifting frequency because of air temperature changes caused by the blowers as they warm up.

As a general summary of the discussion of errors, all known errors can be added together as though they were on the high-frequency side for one tone and on the low-frequency side for another. These two tones would be apart by 0.01 per cent. With respect to A, these tones would be out of tune by 0.005 per cent; with respect to all other tones in the scale, each would be off from 0 to 0.01 per cent. Statistically, the chances are remote that all errors would occur in one

direction and that maximum errors would be attained for each individual item. It is thus possible to estimate that this electronic system has the capability of tuning all tones to an accuracy of better than 0.01 per cent.

Because this system references each tone independently to the organ "A," this electronic method does not permit each tone in the scale to accumulate the sequential errors of each tone previously tuned. The worst theoretical condition in a progression used by conventional piano tuners would be the accumulation of a 0.005 per cent error for each of the eleven tones: the last (11th) note to be tuned would have a resultant 0.055 per cent addition error. Here, again, the cancellation of errors minimizes the occurrence of such an event. Piano tuners utilize final check combinations of 6ths, 3rds, and so on, to insure that errors are not adding more in one direction than another. This method of tuning makes the compressed 5th and expanded 4th system workable, but this system and others using sequential tuning are inherently less accurate than the all-electronic system.

Off-Standard Organs

As previously stated, the electronic tuner should be calibrated to match the standard of the country in which the device is to be used. Likewise, the tuning

fork obtained for the secondary standard should produce a signal somewhere near the frequency of the local standard "A." With basic equipment (the fork, scope, and tuner), off-standard organs can also be tuned with assurance.

The calibrated fork "A" is used to determine the exact frequency of the organ's off-standard "A." For example, if this note is 5.5 cps higher than a local 440-cps standard, then the off-standard curves shown in Fig. 1 and 2 can be used to establish the new dial settings for each of the tones. These settings would be: A = 52.0 (reference): C^{#4} changed from 14.3 to 15.5; A^{#4} from 24.8 to 25.6; B⁴ from 10.6 to 12.0; C⁵ from 72.7 to 72.0; C^{#5} from 18.3 to 19.3; D⁵ from 37.5 to 37.9; D^{#5} from 64.1 to 63.7; E⁵ = 48.4 unchanged; F⁵ = 45.0 unchanged; F^{#5} = 51.9 unchanged; and G⁵ from 68.9 to 68.4. Thus, a calibrated tuning fork can provide a reference from which an off-standard organ can be retuned as accurately as a 440-cps instrument; the organ, however, still retains its 445.5-cps identity.

Frequency Measurements

An additional application for which the electronic tuner can be used is the measurement of frequencies in the audio spectrum. As a tuner, the device is preset to establish certain spot frequencies that are musically related. As a fre-

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2-64

quency meter, the device can also be used to determine the frequency of signals from other equipment.

The tuner is used with the same scope, tuning fork, and calibration curve used for tuning keyboard instruments. First, the tuner dial is set with the tuning fork generator to establish 52.0 divisions as 20,000 cps. The signal of unknown frequency is fed to the vertical terminals of the scope and the tuner dial is varied until a single line of sine wave is synchronized. The dial reading and calibration curve are then used to determine the tuner frequency. This reading is multiplied by the number of sine waves in the pattern to determine the frequency of the unknown signal.

All audio frequencies above 880 cps are determined with full sine-wave patterns. Between 440 and 880 cps, alternate single and double sine-wave patterns are used. When this double pattern synchronizes, the multiplier is determined by dividing the number of peaks at the top of the pattern by two.

More complex patterns can be used to determine frequencies below 440 cps, but the patterns become more difficult to identify. Therefore, for frequencies below 440 cps, the range knob is first calibrated, and then used to determine frequencies between 175 and 440 cps. *Figure 5*, a calibration curve for the range knob of the 20-cps tuner, covers the range from 19.4 to 20.5 cps and provides full coverage above 175 cps. Below 175 cps, the following spot coverage is available: 19.4-20.5; 29.1-30.7; 38.8-41.0; 48.5-51.3; 58.2-61.5; 68.0-71.8; 77.6-82.1; 87.5-92.3; 97.0-102.5; 106.8-112.8; 116.5-123.0; 126.0-133.2; 136-143.5; 145.5-153.8; 155.2-164.0; 164.8-174.2; and 174.5-184.5 cps.

Primarily, this device is an organ tuner which allows any technician, serviceman, or organ owner to complete an organ service job successfully. In addition, it can be used to measure audio frequencies and to calibrate other devices and equipment. With these features, the electronic organ tuner is an inexpensive but versatile addition to the service shop and laboratory. Æ

POWER

(from page 26)

The significance of the IM curves should not be ignored, especially in transistor amplifiers. One common characteristic is that the IM rises at low power levels. This characteristic is much less desirable than high IM at rated power. A typical curve is shown in *Fig. 3*.

Ratings for stereophonic amplifiers are unusually unrealistic. The current practice is to determine the rating of

one amplifier (such as the left channel), and multiply this figure by two to encompass the two power amplifiers (left plus right channel). Although reasonable for IHF ratings, this procedure does not include the power supply regulation factors important in the continuous-power test. To compound matters, the result is frequently multiplied by a second factor of two to present an astronomical continuous peak power rating.

By means of this number game it can be shown that virtually no low-power amplifiers exist (although in reality they are the most prevalent).

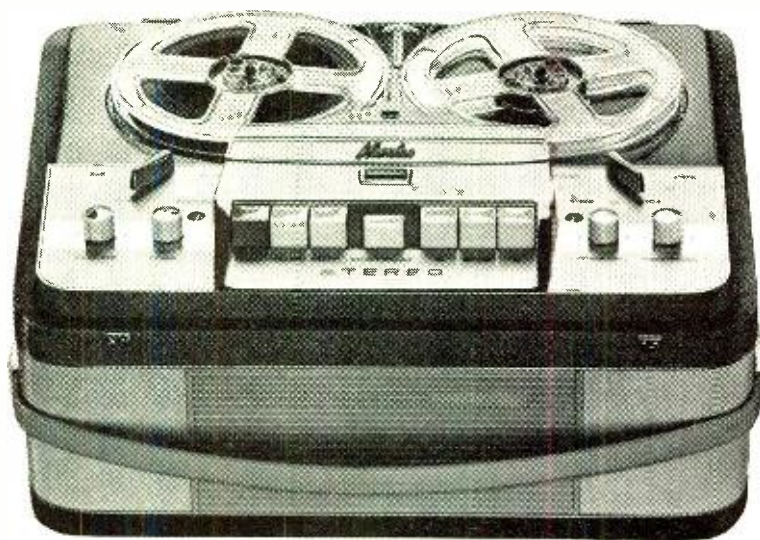
Manipulation of numbers can easily raise a dual 12-watt stereo amplifier to a rating of 80 watts. This can be done as follows:

A 12-watt amplifier can easily have an 18-watt music power rating. Two such amplifiers on one chassis means that 36 watts of IHF power is available. Multiply this by two and you now have a 72-watt peak IHF power amplifier. How come 80 watts? After all this, is it so terrible to cheat a tiny bit for a measly 8 watts? And if your line voltage is high, you're not really cheating.

What a mess!

Æ

all signal no noise



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RECORDS

(from page 61)

Tschaikowsky: Three Great Ballets—Swan Lake, Sleeping Beauty, Nutcracker. Minneapolis Symphony, Dorati.

Mercury SR6 9014 (6) stereo

Phew—what a whopper of an album! Six LP records, all Tchaikowsky, all ballet music. I like it; though I do not pretend, yet, to have played every note of all six sides. That's for tomorrow (and next year)—for me and for you. It's an album that will last and last.

Assiduous readers of this department, if there are any, will note a pro-Dorati shift in my feelings of late. I used to dislike his hard, pounding, metronomic approach to many types of music from the Beethoven era all the way to Stravinsky. Well, something has changed, something has mellowed. It could be no more than Mercury's microphones—but this I doubt! In any case, the best in Dorati is now being paraded out for us, whether from Europe or via his once home-orchestra, where he now guest-conducts, as in this album. He is, above all, an expert ballet man and is, above all, at ease in this sort of music, which is perhaps the highest-level background music since Mozart.

Don't play too much at a time. Do use it for a background—it was so intended, and never for concert-style listening.

Moussorgsky: Pictures at an Exhibition (orch. Ravel). Debussy: Prélude à l'après-midi d'un Faune.

Philharmonia Orchestra, Maazel.

Angel 36132 stereo

Young conductors by their very age must act flamboyant, or sink into obscurity. The podium spotlight is more easily graced by the old lions, who can be dramatic and mellow all at once.

As I listened to this I could not see Lorin Maazel, of course; but I heard him. And knowing his age, I sensed the inevitable. I didn't much enjoy this record of old-line classics. With one of the world's best and most sensitive orchestras playing, the works seem to me to come off the assembly line with rough edges and irascibility. I have the feeling that this seasoned ensemble of orchestral players if left to themselves could do a more knowledgeable styling of the music, if perhaps with lower voltage, than they do here under an evident youthful prodding. I don't mean Maazel isn't an experienced expert at conducting; it's just that these works, of an earlier recent era, still require a mellowness that is not really comprehensible to many of the younger musicians. It isn't here. It is still evident in many other recordings.

MORE UNUSUALITIES

Haydn: The Sturm und Drang Symphonies (Nos. 44-49). Symphony Orch. of Radio Zagreb, Janigro.

Vanguard VSD 2145,6,7 (3) stereo

These seem like an almost personal gift to me—for it has been maybe 30 years since I "discovered" the extraordinary expressiveness of the only one of these earlier Haydn Symphonies that has been long known, the so-called "Farewell," No. 45. That one has stayed in the repertory for false reasons; it is the symphony in which, during the last movement, all but two of the musicians quietly leave the stage. Haydn was making an ingenious plea to his Lord and master to, please, let the musicians go home for a rest after an arduous season. The "Farewell" has often been re-enacted, complete with 17th century pigtailed and candles being blown out—but what really matters is the wondrously expressive music itself, not the trick ending.

The "Sturm und Drang" period ("storm and stress") was an oddly short burst of

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sheer Romantic feeling that erupted in European literature via Rousseau and Goethe in the late 1760s and spread into music as well—odd, because in surprisingly short time it was all over. In Haydn, it brought forth the most poignant music in his whole output, and never again—on until the middle 1790s—was it apparent. It spreads merely from Symphony No. 44 (“The Sad”) through Symphony No. 49 (“The Passionate”); thereafter, the sun shines regularly through Haydn’s enormous output right on through No. 104, the last.

Janigro’s Yugoslav performance is of an Italian cast, surprisingly unlike the Viennese Haydn performances that have been staples in this musical era, notably the new Library of Recorded Masterpieces series with Max Goberman. More nervous, more rapid in flow, occasionally rather metronomic, these performances display lovely string playing and less inspired brass and woodwinds as well as a rather indifferent treatment of the ornamentation. The Viennese winds are more notable—and, incidentally, there are significant differences in wind scoring, as in the “Maria Theresa,” No. 48, due to unresolved inconsistencies in the surviving scores or parts.

Much in these superb works remind us of Mozart—in his later symphonies, long after the Haydn symphonies were composed; much, indeed, that should inspire music historians to revalue the conventional “music appreciation” attitude towards old “Papa Haydn,” dating from the times when these powerful early Haydn works were simply unknown, both to music audiences and music historians. Amazing how easily we ignore what we wish to ignore—until we change our minds! We’ve changed our minds about Haydn, all right, and I am glad. As I say, I’ve waited 30 years. . . .

Couperin: Les Nations (“La Françoise”; “L’Espagnole”). The Jacobean Ensemble, Dart.

L’Oiseau-Lyre SOL 251 stereo

Though you will not find much of present-day French or Spanish idiom as we know them in these “ordres” or suites for trio of two violins and a viola da gamba with harpsichord accompaniment; you will find a great deal that is ornamentally French, a style that, while unfamiliar, is quickly becoming more familiar as we explore the hitherto virtually unknown French music of the Seventeenth and Eighteenth centuries at the great courts of the Louis, XIV, XV and XVI.

The very British performance is meticulous as to the details of ornament, according to the latest wave of interest in authentic aberrations from the written notes—quarters, slurred, are played unevenly, the first shorter than the second like a Scotch snap, for instance. Nevertheless, there is a certain old-fashioned and rather anachronistic sound to these performances that is evidently quite unconsciously produced by the performers. Hard to pin down, but important for those who like up-to-date musicological performance.

It’s surprising how varied are the results, all supposedly from the same originals, when the various national groups undertake to be “authentic” today! Each plays according to his lights and they are all vastly different.

Schumann: Davidsbündlerfänze; Carnival. Charles Rosen, piano.

Epic BC 1269 stereo

Epic’s excellent pianist, a sober, eloquent modernist of the short-haired type, not only plays a very fine pair of big Schumann works here but writes an interesting back cover, not at all the usual re-hash of somebody’s program notes but a good historical discussion of Schumann and a very personal account of the music itself. He writes well. He plays well.

The “Dances of the League of David”—in case you have been seeing double at all that German—refer to Schumann’s long-time fanciful league of the *real* people against the musical Philistines; I find myself thinking of the analogy just about twice a day, these years, what with our own myriads of musi-

cal Philistines. The League is also featured in the earlier “Carnaval,” much more familiar to most listeners; there are even musical themes in common between the two. In a way, these large collections of many short and contrasted little pieces are an outgrowth of the older Dance Suite, as written by such as Bach and Handel. Nice idea.

Schumann himself was not only a fine pianist and composer but a fluent literary man; Charles Rosen thus has much in common with him, in a young 20th century sort of way.

Mozart: Serenade for 13 Winds in B Flat, K. 361. (Complete Wind Music, Vol. 1) London Winds Soloists, Brymer.
London CS 6346 stereo

A good deal of Mozart’s wind music is light and heady stuff composed mainly for outdoor gatherings and artful street serenades as commonly practiced in Salzburg and Vienna in his time. But this big piece, scored for a most unusual combination of winds on a rela-

tively large scale, is one of his profound works in spite of its outward gaiety. Once learned, it is unforgettable, in all its seven movements.

The most unusual feature of the wind group is the use of two clarinets and two basset horns, a peculiar low-pitched clarinet still used today for its unusual tone color. (No relation to a basset bound other than being low-hung in pitch.) The four clarinet-family instruments plus three bassoons, four horns and two oboes make a brilliant and solid ensemble with immense variety of color. The British performance is thoughtful and highly professional in its polish.

Flamenco. Pepe Romero, guitar.
Mercury SR 90297 stereo

Phew! An ultra-violet flamenco player, hepped up—sounds like he’s breathing pure oxygen and munching pep pills. Never heard such a guitar powerhouse. This review is late—never too late for this kind of stuff. Very hi fi. **AE**

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Figure 8



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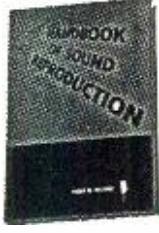


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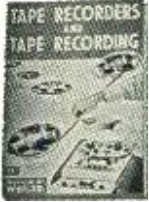
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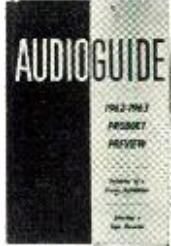
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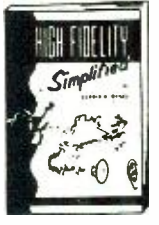
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HOUSEFUL OF HI-FI

(from page 48)

more convenient, any two-conductor cable may be used for the speaker connections in place of these wires. Use of a common (ground) wire for both speakers should be avoided, since crosstalk between channels will result. **Æ**

PARTS LIST

Symbol	Description
C_1	2000 μ f, 6-v, electrolytic
CR_1, CR_2	Diode 10 A, 200 PIV (Lafayette Radio SP267)
K_1, K_2	6-v d.e. coil, dpdt, Potter and Brumfield KA11D
$K_3, K_4,$ K_5, K_6	115-v a.e. coil, spdt, Potter and Brumfield KA5AY
K_7	6-v d.e. coil, spdt, Potter and Brumfield KA5D
L_1	0.75 hy, 300-ma choke, Stancor C-2343.
Reset Pawl	115-v a.e. coil (contacts removed) Made from Allied Control PB-9A
R_1, R_2	25-ohm, 25-w ww pot., Ohmite 0147
S_1, S_2, S_3	Double pole, 5-position rotary, Mallory 3226J
S_4, S_5, S_6	spst, N.O. Push switch, Lafayette Radio MS-449
S_7, S_8	Double pole 3-position rotary, Mallory 3223J
S_9	dpdt rotary, Mallory 3222J
T_1	5v-0-5v, 5A transformer, Stancor P6458

PHONO SYSTEMS

(from page 40)

most practical way to achieve the ultimate in distortion-free reproduction. However, even now when the correct vertical tracking angle is maintained in both recording and playback and when DRC techniques are used in recording, conventional-type pickups and styli can provide reproduced sound from stereorecords in which distortion is reduced to exceedingly low values. Nevertheless, we must acknowledge that the measured distortion is still not zero. The small amount of distortion which remains is due to a number of elements in the record-playback system, each of which contributes its small share. Further reduction of this residual distortion will require a much more rigid control of all processes and components within the system than has been practiced heretofore. **Æ**

CORRECTION

In Part I of this article Fig. 6 and 8 were interchanged. Fig. 6 should have been Fig. 8 and vice versa. The captions are correct.

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● **RCA Phototube and Photocell Manual.** The RCA Phototube and Photocell Manual, a first edition and the latest in a series of RCA manuals, promises to be a valuable tool for the circuit engineer who works with photosensitive devices. Describing both phototubes and photocells, this new manual offers theory, design, and application information in one handy reference source. A partial listing of the contents includes: Theory and Measurements; Gas Phototubes; Vacuum Phototubes; Multiplier Phototubes; Photocells; Application Considerations; and Technical Data. Price for the manual, PT-60, is \$1.50. Radio Corporation of America, Electronic Components and Devices, Lancaster, Pa.

NEW LITERATURE

● **Antenna and Accessory Line.** A new 16-page, two-color brochure (Catalog DS-C-502) describing Jerrold-TACO's complete lines of antennas for both black-and-white and color TV markets, and FM-stereo models for master antenna systems, has been issued by the Distributor Sales Division of Jerrold Electronics Corporation. One section describes omni-directional FM antennas and antenna kits plus the Jerrold-TACO family of FM stereo-multiplex antennas, of which the latest addition is the Paralog highly-directional FM units. Data is also contained on antenna bi-mounts, mixing couplers, TV set couplers, switches and attenuators, impedance transformers and traps. Full information is also given on both the Super-Powermate and Powermate. Jerrold Electronics Corporation, 15th Street and Lehigh Avenue, Philadelphia 32, Pa. **C-11**

● **1964 Sony Line.** The 1964 line of Sony tape recorders, microphones, and accessories is illustrated in a new 16-page full-color catalog just released by Superscope Inc., exclusive U.S. distributor. Titled "All New From Sony," the catalog contains individual color photographs, descriptions, features and specifications of the 11 Sony recorders. The new Sony/Superscope color catalog is available at all franchised Superscope dealers. Superscope Inc. is located in Sun Valley, Calif. **C-12**

● **High-Fidelity Loudspeakers and Kits.** Jensen Manufacturing Company, Chicago is offering a 24-page two-color catalog, No. 165-J, describing the newest in Jensen loudspeakers, headphones, private stereo listening, speaker components, and speaker system kits for customizing or economizing. Complete acoustical and dimensional specifications and prices are given. Among the many Jensen products included in the catalog are: the new Sigma Series; Tri-axial and Triax 3-way 15-inch unitary speakers; for the do-it-yourselfers who wish to make the enclosure or build-in, four complete speaker system kits and a "step-up" speaker performance kit are offered plus many other products and accessories. Jensen Manufacturing Company, 6601 South Laramie Avenue, Chicago, Ill. 60638. **C-13**

● **Transistor Circuits for Magnetic Recording.** With the application of transistor circuits to magnetic recording equipment, there has arisen the need for a comprehensive explanation of transistors as they apply to magnetic recording. Transistor Circuits for Magnetic Recording, by N. M. Haynes, is a practical book, describing in detail the application of transistor circuits to magnetic recording. The author completely explains the functions of the most elaborate and sophisticated circuits in language that can be understood by the knowledgeable hobbyist or experimenter as well as the professional engineer. Also included is a valuable analysis of the present state of transistor recording circuitry in other countries. The book is divided into four parts. Part I deals with the most important transistor characteristics as they affect magnetic recording circuit operation. Part II, Magnetic Recording Elements, includes a review of the basic essentials of magnetic recording, with particular emphasis on those characteristics most likely to be affected by the use of transistor circuitry. Part III, Sectional Circuitry, explains modern techniques used to analyze and evaluate any type of magnetic record and playback circuit. Also included is a discussion of transistorized motor speed control for satellite recording. Part IV, System Circuitry, analyzes the state of the field by describing commercial circuits currently being used in the United States, England, Germany, Switzerland, and Japan. Techniques and circuits used in frequency modulation and digital recording are also described. Howard W. Sams & Co., Inc., Indianapolis, Indiana.

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Fig. 1. Jean Marantz cuts cake whereon inscription reads "Happy Birthday Dear Tuner." We understand the baker asked, "Is Tuner a boy or a girl?" The icing was blue.

• **AKG Microphones Sets Up New U. S. Distribution.** AKG of Vienna, manufacturers of fine condenser and dynamic microphones, is now represented in this country by AKG of America, a division of North American Philips Company, Inc., with headquarters at 125 Park Avenue, New York City. Effective January 1st, the new division has become the sole authorized distributor of AKG products in the United States, according to Fritz Sippl, director of international marketing for AKG. John H. McConnell, recently assistant to the president of Reeves Industries, Inc., has been named product manager of AKG of America. Mr. McConnell is well known in the field of electroacoustics, in which he holds six patents. Repairs and service, as well as a complete inventory of AKG products, will be available at the AKG service center at 30-10 Review Avenue, Long Island City.

• **New Altec Division.** A. A. Ward, President of Altec Lansing Corporation, a subsidiary of Ling-Temco-Vought, Inc., announced today the formation of a new division to be known as Audio Controls Division specializing in the design and manufacture of precision attenuators, equalizers, filters, networks, and switches, as well as, custom consoles and associated products directed to the specialized requirements of the recording, broadcast, military and commercial sound fields. The new Audio Controls Division will be headed up by Arthur C. Davis who has been well-known in this field for many years as a leading design-engineer and manufacturer. In 1937, Mr. Davis organized the Cinema Engineering Company and managed its successful growth until ten years ago. Until recently Mr. Davis was in a similar capacity with Langevin, a division of Sonotek, Inc. A new plant and laboratory has been completed by Altec in Anaheim to facilitate the engineering development and production of Audio Controls complete line of products. The distribution of these new products will be channeled through Altec Lansing's present marketing structure.

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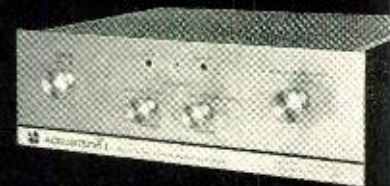
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*High Fidelity Magazine, August, 1962
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New, from Electro-Voice! Sentry Series Professional Monitor Loudspeakers . . . guaranteed flat ± 3 db from 40 to 20,000 cps!

No longer must you improvise with theatre or home-type hi-fi speakers designed for some other purpose. Gone is the guesswork when equalizing . . . you know you'll get *exactly* what you hear through an E-V Sentry Monitor. That's because each Sentry is simple, reliable and as flat in response as modern science can make it!

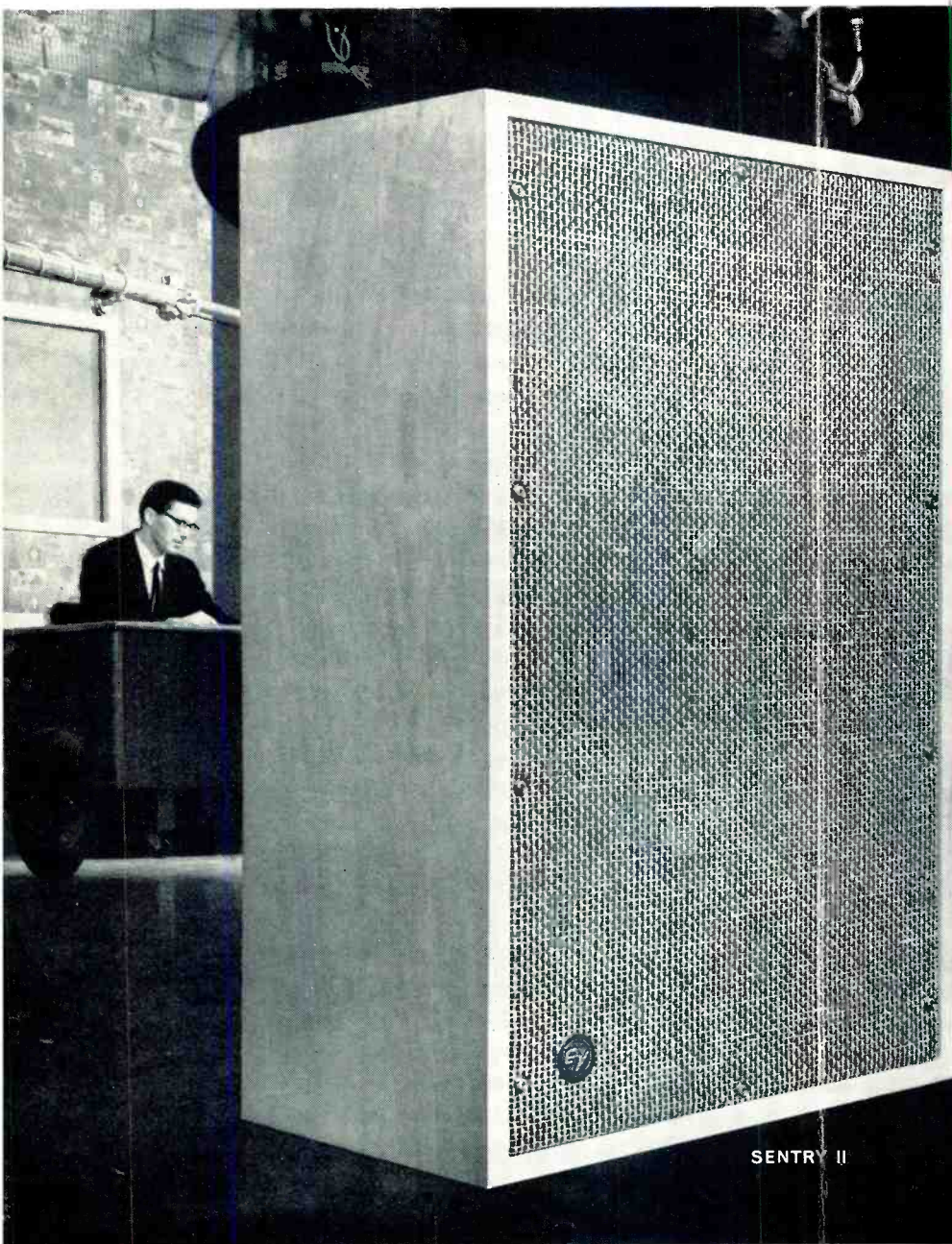
Gone are "balance" switches or knobs that vary response . . . each Sentry is adjusted flat at the E-V laboratories before you ever see or hear it! And because of this simplicity, the E-V Sentry Series speakers are modest in size and price.

NEW VOICE OF AUTHORITY!

The natural-finish hardwood cabinets are available in a sloping-front style for wall or ceiling mounting . . . or in an upright floor model for fixed or portable applications. They are all identical in sound. Built-in transformer matches studio output impedance of 8, 16 and 600 ohms.

If you want to end equalization guesswork . . . if you want to know that the sound you hear is an exact duplication of the original . . . the E-V Sentry Series Professional Monitors were designed for you. Write for complete specifications, or see your E-V Professional Products Distributor, today!

Sentry II Floor Model, 32" H, 20" W, 13" D. List Price \$265.00. Sentry I Wall or Ceiling Model, 17" H, 37" W, 21 1/4" D. List Price \$248.33. (Normal trade discounts apply.)



SENTRY II



SENTRY I

Electro-Voice®

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