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AUDIO

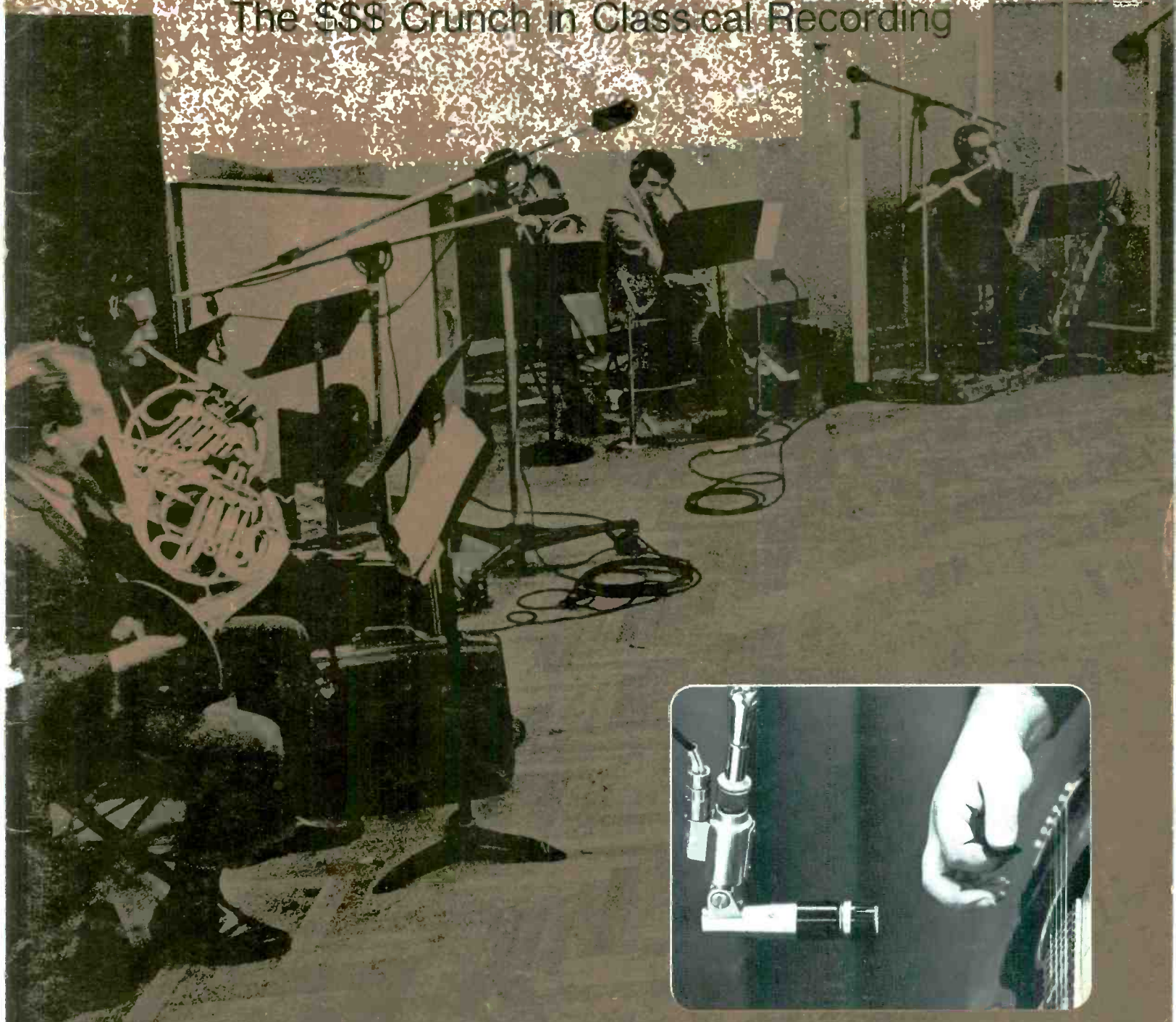
STEREO EQUIPMENT & RECORD REVIEWS

MAY 60¢

A Studio View of a "Pop" Recording Session

Crossover Distortion in Transistor Power Amplifiers

The $$$ Crunch in Classical Recording

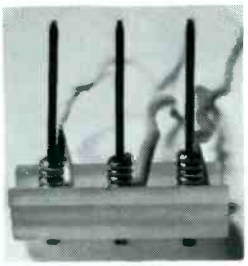


Tomorrow's electronics for today's enjoyment

new Scott 342C 100-watt FM stereo receiver

NEW 100-WATT SCOTT 342C...THE WORLD'S MOST INCREDIBLY ADVANCED RECEIVER!

A light that snaps on automatically when you're perfectly tuned:
Perfectune® is a miniature computer . . . the most effective way to tune for lowest distortion and best reception.



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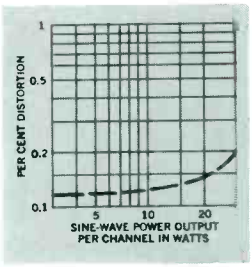
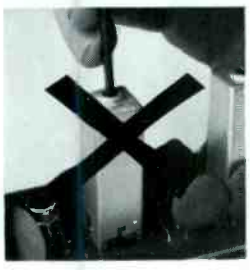
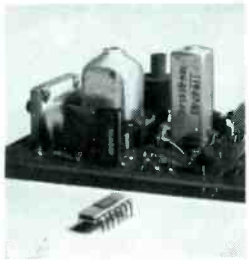
No more solder-joint failures! Reliability-proven in demanding aerospace applications.



New F/C/O circuitry gives virtually distortion-free listening, even at low volume levels:
Scott's new Full Complementary Output means perfect sound at *all* volume levels. And . . . extra power is available at 4 Ohms output, vital when you want to connect extra speakers.



A quartz crystal lattice filter IF section:
Regardless of age or operating temperature, your 342C IF amplifier will never need realignment.



New IC Multiplex section gives better performance and reliability in FM stereo:
No larger than a cigarette filter, Scott's exclusive Integrated Circuit contains 40 transistors and 27 resistors.

Printed circuit modules snap into main chassis:
Eliminates solder joints and provides for instant servicing.

Plus these famous Scott features:

■ Silver-plated Field Effect Transistor front end ■ Integrated Circuit IF strip ■ Integrated Circuit preamplifier ■ Field Effect Transistor tone control ■ All-silicon output circuitry.

Check this unbelievable price:
342C 100-Watt FM Stereo Receiver ..... only $259.95!

342C Specifications:
Power: IHF ±1 dB @ 4 Ohms, 100 Watts; IHF ±1 dB @ 8 Ohms, 80 Watts; Cont. Output, single channel, 8 Ohms, 30 Watts; IHF Sensitivity, 1.9 μV; Frequency response ±1 dB, 20-20,000 Hz; Cross modulation rejection, 80 dB; Selectivity, 40 dB; Capture ratio, 2.5 dB. Prices and specifications subject to change without notice. Walnut-finish case optional.

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AUDIO

May 1969 Vol. 53, No. 5

Successor to RADIO, Est. 1917

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Coming in June 1969

Can Crossover Distortion Be Detected By Ear?—James Bongiorno compares modified versions of transistorized power amplifiers and a tubed power amplifier in a listening test to learn if crossover distortion reveals itself to the ear.

Post Recording Session Techniques — John Woram discusses the re-mix or tape mastering methods used **after** a recording session is completed.

. . . and more.

EQUIPMENT PROFILES:

EICO Model 3150 stereo integrated amplifier and Model 3200 stereo FM tuner, Thorens Model TD-125 "Electronic" manual turntable, and others.

ALSO: Record and Pre-Recorded Tape Reviews, ABZs of FM, Sound & Decor Styles, and other regular departments.

ABOUT THE COVER: The brass section of an orchestra is shown during a recording session. Trumpets, not shown, are behind the sound baffles, between the french horns and the trombones. In the spot photo, a Shure 546 dynamic microphone is used in close for an "up tight" pickup of the guitar.

Audioclinic

JOSEPH GIOVANELLI

If you have a problem or question on audio, write to Mr. Joseph Giovanelli at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

Ping-Pong Stereo

Q. A friend of mine has a stereophonic set. The sound jumps from one speaker to the other. In my stereo music system, the sound does not. What's wrong?—R. Roy Downsview, Ontario, Canada

A. Some recordings are designed specifically to bring about this stereo effect. Classical music discs are not so designed, and not all "pop" records are so made. Therefore, it may simply be that the records you are using are not dramatic, and hence you do not obtain the obvious type of stereo, known sometimes as "ping-pong stereo." If your friend was playing a record, borrow it from him and play it on your equipment. You should obtain the same effect that he did unless something is wrong with your system. We will discuss that possibility now.

If two speakers are placed very close together, you will not obtain much in the way of stereo information. Both speakers will produce sound, but their proximity to one another will mean that the sound from both speakers is being radiated from virtually the same point source. Therefore you cannot obtain a stereo effect. For the average listening room, a separation of the speakers of between six and eight feet would seem ideal. If you still do not obtain stereo, we must look to something else.

First, are both speakers working? If they are, and you are not getting stereo, the sound should be coming from a point midway between the two speakers. If it appears to be coming from two separate locations, reverse one set of speaker leads, leaving the other speaker wires as before. This should enable you to hear all mono sounds from the center, between the two speakers. Making this simple change can result in marked improvement of the stereo effect.

Do you get stereo from your tuner and not from the phonograph? It might be that you have your cartridge wired incorrectly. Check the wiring against that shown in the instructions which came with the cartridge.

Check to see that the amplifier connections to the speakers are correct. Perhaps one channel is shorted out. Perhaps you have accidentally wired two channels in parallel.

Check to see that all your controls are set to receive stereo, whether from FM or from phonograph.

If none of this works, you will need to trace through the amplifier stage by stage to find where the stereo separation is lost.

One Too Many Leads?

Q. My problem is that I have a dynamic microphone which has two leads, one white and one red, inside the shield. My tape deck, however, will accept only the conventional phono plug with one lead and shield.

Is there any way I can adapt this microphone so that it will be useful in this situation?—J .C., El Paso, Texas

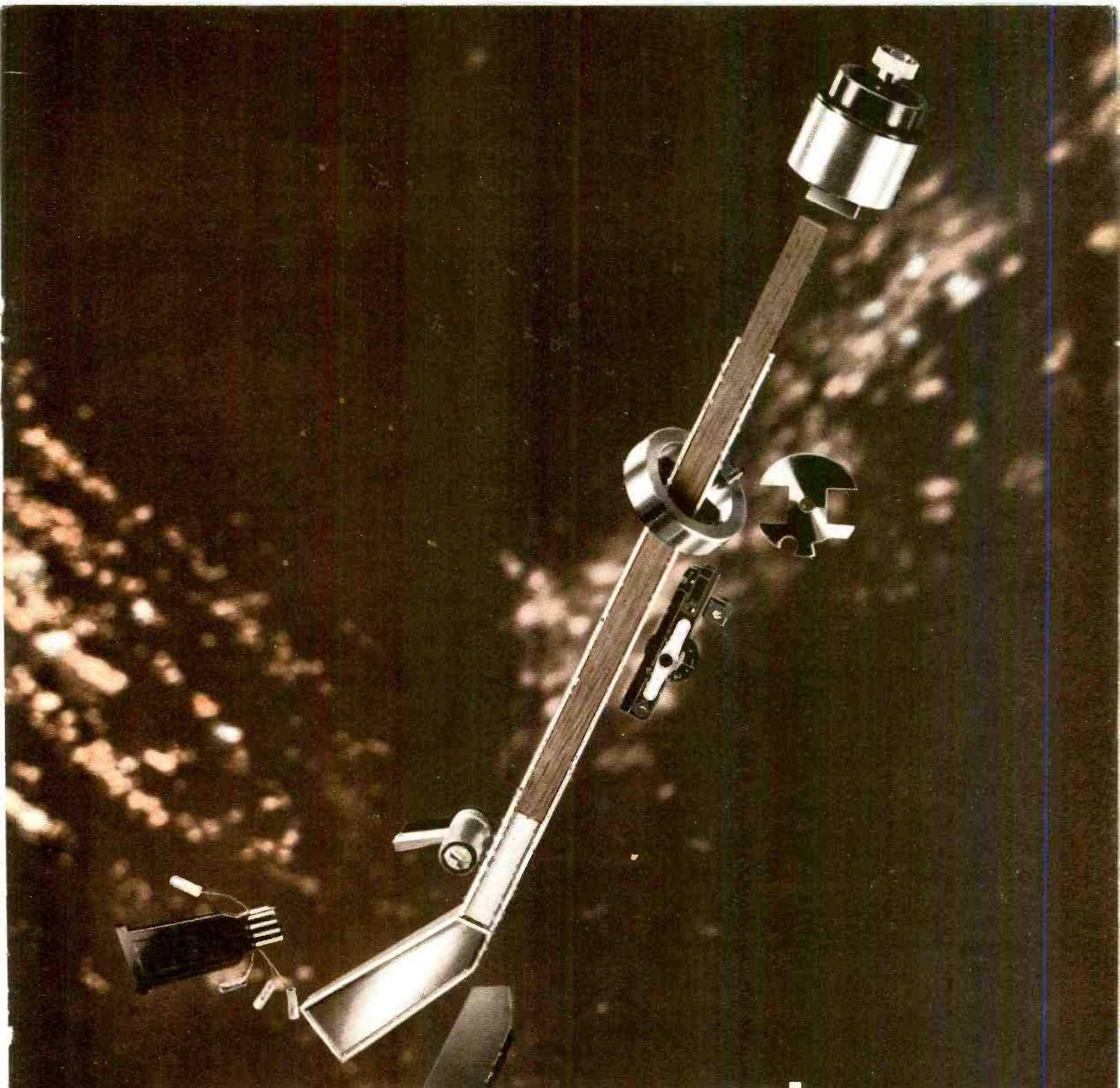
A. All else being equal, you will have no trouble using your microphone with your tape deck. Connect the white lead and the shield together, and connect this combination to the ground side of the phone plug. The red lead goes to the "hot" side of the plug.

I said "all else being equal" for a reason. If the mike is low impedance and your tape recorder is high impedance, you will not get much output from the mike. If the mike is high impedance and the tape recorder is low impedance, you might or might not have sufficient output. There is a possibility that your mike will lack bass to some degree. Especially in the first instance, you can cure the problem by using a mike transformer to match impedances between the mike and the recorder. That scheme might also be tried in the second instance, but the transformer would have to work backwards. The winding which is normally the primary would serve as the secondary, and vice versa.

A.C. Line Transients

Q. Twice recently I have had extensive power-supply damage in completely separate pieces of equipment. I feel certain this damage stems from the a.c. power line.

I observe "spikes of over 400 volts



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The tonearm on the synchronously powered SL 95... a breakthrough in stellar performance. Meticulously engineered—precision assembled, it forms a completely integrated cartridge transport system—the most advanced tracking mechanism on any automatic turntable. Pictured here, top to bottom, the galaxy of refinements in this exceptional arm: Fully adjustable counterweight for dynamic balancing • Rigid, one-piece aluminum construction • Insert of Afrormosia—least resonant of woods • The gyroscopically gimballed mounting in which the arm floats, on needle pivots, virtually friction-free • Tiny ball bearings for freedom of movement • Calibrated stylus pressure gauge • Tonearm safety rest • Slide-in cartridge clip that assures positive alignment. Not shown: The patented, permanently accurate sliding weight anti-skating control • Safe, gentle cueing/pause control • The incomparable Garrard expertise... more than 50 years building the world's finest record playing equipment. For complimentary Comparator Guide, write Garrard, Dept. AE2-8, Westbury, N.Y. 11590.

Garrard® SL95

Feature by feature, today's most advanced automatic turntable.

displayed on an oscilloscope. These transients are of very short duration and do not show up on a conventional recording voltmeter designed only to show average voltage fluctuations. However, they do last long enough to destroy transistors completely.

Can you suggest a protective circuit using Zeners or other devices that would offer adequate protection without destroying itself in the protective process?—C. R. Witherspoon, Omaha, Nebraska

A. Any power line contains transients, voltage peaks which indeed often reach 400 volts. These peaks can result in the producvtion of transient "clicks" in equipment.

This may surprise you at first, but look at it again. There are capacitors in the power supply of your solid-state gear. When power is first applied, these capacitors take a charge which is proportional to the applied voltage. Further, this charging action takes a measurable amount of time. Should the voltage fall somewhat, the capacitors will discharge into the load, thereby attempting to maintain the original charging voltage. If the under-voltage condition remains for a time, there will come a point where the original charge is not sufficient to maintain the original operating conditions, and the circuit will then run at reduced voltage.

If the voltage increases rather than drops, the capacitors will again attempt to maintain the operating voltage while they are charging up to the new voltage. If the transient voltage is of very short duration (as it would have to be if we term it "transient"), the capacitors will not have an opportunity to obtain even a small fraction of the charge which would have been required to raise the voltage applied to the external load. Thus, the power supply has a built-in protective mechanism.

If you are having trouble with a particular piece of solid-state gear, it may be the result of poor design, rather than power-line problems.

My thought is that if you cannot see the increase in voltage on a voltmeter, the load presented by our solid-state gear will not be damaged. This built-in protective system is all that is required.

Improvised Heat Sinks

We all know how important it is to use a heat sink to remove heat from semiconductor devices when soldering to the leads. There are commerically available heat sinks for this purpose. However, if you do not have such a device, you still can solder to the semiconductor without damaging it if you use a makeshift one.

For example, you can use an alligator clip. Make sure that it grips the lead firmly before soldering.

If you don't have an alligator clip, you can use a pair of tweezers. Use a strong rubber band to hold them closed.

If this is unavailable, use a pair of long-nose pliers. Here again, a rubber band can be used to hold the pliers closed.

The main consideration here is that there be sufficient conductive material to remove the heat. However, the tip must be small so it can fit between the body of the device being installed and the point on its leads to which solder is applied—*Name Withheld* Æ

Book Review

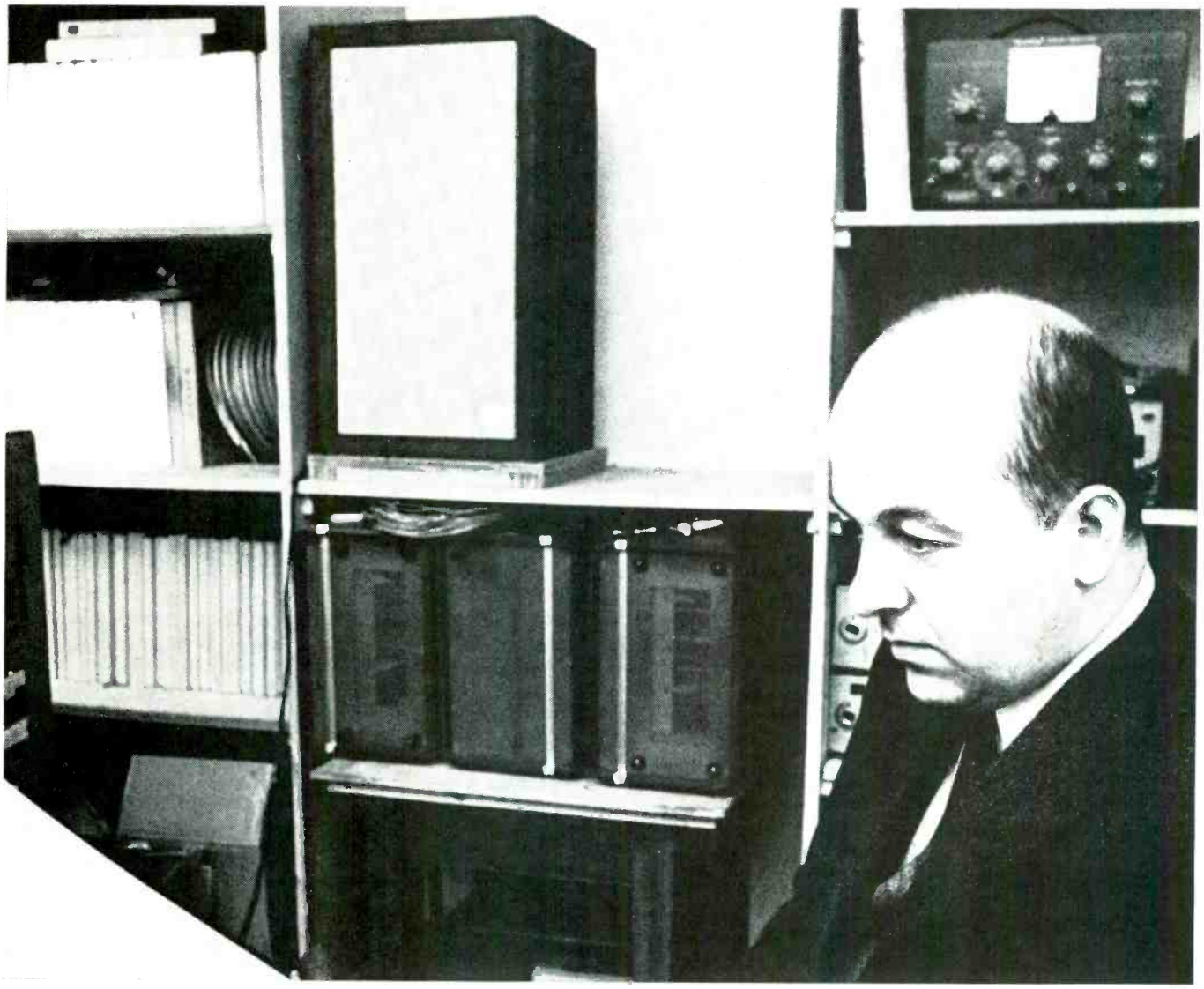
Reference Data for Radio Engineers. Fifth Edition. Ed. by H. P. Westman (technical publications editor) and Melvin Karsh associate editor). 1150 pages; 1350 illustrations. Howard W. Sams & Co., Inc., a subsidiary of ITT, Indianapolis, Ind. $20.00.

This one-volume reference book is of immense usefulness. Ask any engineer—radio, electronics, telephony—who has one of the previous editions and he'll doubtlessly agree. If you want to place your finger on a formula, get a thumbnail sketch of a special area in electronics or allied fields, the chances are that this reference volume will provide the answer.

Greatly enlarged and revised, it includes seven subject areas that were not covered by the fourth edition, including space communications and quantum electronics. As important as the text and generous number of illustrations is the volume's index and cross-index.

It was all started in 1942 by a British subsidiary of ITT. The first effort was a 60-page brochure, published as a "complete," reliable reference source for the radio and electronics engineer. It grew from there to its present 1150 pages, and from the looks of things will continue to grow with succeeding editions. And to give you some idea about the new material in the volume (50 per cent is said to be brand new), stereo FM was not in the previous edition, which was published in 1956. Æ

Because accuracy of reproduction is essential, AR-3a speaker systems are used by Connoisseur Society.



For their Vienna recording sessions with internationally distinguished Czech pianist Ivan Moravec, Connoisseur Society brought AR-3a speaker systems from their New York facility. Earlier recordings by Moravec on Connoisseur Society records have received awards for outstanding technical and musical excellence. The newest release in the series is record CS 2010, piano music of Debussy and Ravel.

Acoustic Research makes AR speaker systems, amplifiers and turntables. All are described in our catalog, obtainable for the asking.

ACOUSTIC RESEARCH, INC., 24 Thorndike Street, Cambridge, Massachusetts 02141
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What's New In Audio

New Transcription Turntable

Elpa Marketing Industries announces availability of a new turntable, the Thorens model TD-125. It incorporates an electronic, transistorized drive system. Among its features are an electronic speed selector and pitch control; three speeds; eight-lb., 12-in. turntable platter; suspended chassis;

synchronous motor; and replaceable tonearm board for mounting the user's choice of a tonearm.

Flutter is reported to be .08%. Dimensions are: 18-in. L x 14-in. W x 5-in. H. Weight is 32 lbs. $185.00; $200.00 with oiled walnut base.

Check No. 127 on Reader Service Card

Interchangeable-Stylus Cartridge

The new ADC 25 stereo pickup includes three easily interchangeable stylus assemblies: #251 is an elliptical stylus with a contact radius of .0003" and a lateral radius of .0007", #252 is an elliptical stylus with a contact ra-

dius of .0003" and a lateral radius of .0009", #253 is a spherical stylus with a lateral radius of .0006". Each is color coded. According to the manufacturer, these styli will enable the user to obtain optimum sound reproduction from the many record brands available, each with their individual groove characteristics.

The ADC 25 features a tracking-force range from ½ gram to 1¼ grams, frequency response from 10 Hz to 24 kHz ±2 dB, channel separation of 30 dB from 30 Hz to 12 kHz and 20 dB from 12 kHz to 24 kHz. Priced at $100.00.

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Audio Literature

Tape Recording Ideas and Hints are outlined in a 35-page handbook, Brochure A68-151, from the Ampex Corporation.

Check No. 129 on Reader Service Card

A Headphone/Private Listening Brochure from Telex Communications, catalog BI-2166, covers over 30 general communications and dictation headphones as well as other private listening devices and accessories.

Check No. 130 on Reader Service Card

A Primer of Stroboscopy booklet is available free from the General Radio Company. It explains fundamental concepts of stroboscopy, accessories for electronic stroboscope, how it can be used with a simple camera, and other applications for the instrument.

Check No. 131 on Reader Service Card

A British Valve and Electronic Industry booklet classifies 72 types of devices with the names of the firms marketing each type. Available free from the General Secretary, BVA/VASCA, Mappin House, 4 Winsley St., Oxford St., London, W1N ODT.

EMT Wilhelm Franz Products: This pocket-sized catalog, available from Gotham Audio Corp., provides capsule data on such products as the EMT-140st steel plate reverberation unit, EMT-930st turntable, and the Studer A-62 and C-37 master tape recorders.

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Building loudspeaker enclosures? Two manuals from JBL offer instructions and hints. CF802, "Enclosure Construction Manual," discusses the basics of enclosure design, the ported enclosure, grille assemblies, typical cabinet construction, joints, bracing, and professional finishing techniques. CF706, entitled "Enclosure Construction for JBL 'F' Series Musical Instrument Speakers," is another manual for do-it-yourself-ers. Actual dimensions and port sizes are given for typical enclosures. 50¢ each from JBL, 3249 Casitas Avenue, Los Angeles, Calif. 90039.

A 12-page bulletin from Pittsburgh Corning Corp. graphically describes its GEOCOUSTICS® units, designed to improve room acoustics. Information on how the 13½-in. square pads are installed, together with tables and charts for estimating the number of units needed in an area, are included.

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unique: revolutionary Sound Effect Amplifier.

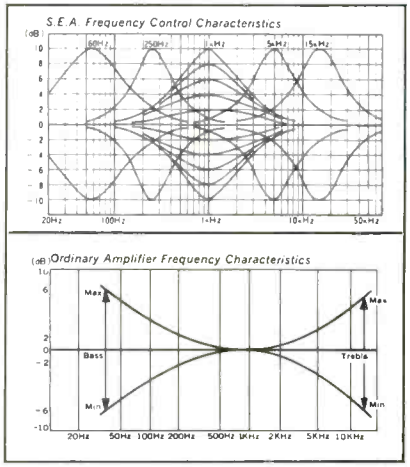
Unique "S.E.A." Sound Effect Amplifier tone control system of models 5001 and 5003 eliminates conventional bass and treble controls. Provides individual control of the five different frequencies that comprise the total tonal spectrum; 60, 250, 1000, 5000 and 15000 Hz.

In introducing the striking all solid state 60 watt 5001 and 140 watt 5003 AM/FM Multiplex Stereo Tuner Amplifiers, JVC brings the stereo fan a new dimension in stereo enjoyment—the complete control of sound effects.

This exciting innovation is made possible through the incorporation of a built-in Sound Effect Amplifier (S.E.A.), a versatile component that divides the audio range into five different frequencies. It enables the 5001 and 5003 to be tailored to the acoustical characteristics of any room, or to match the sound characteristics of any cartridge or speaker system, functions that were once reserved for expensive studio equipment. But even without the built-in S.E.A. system, the 5001 and 5003 would be outstanding values. They offer improved standards in FM sensitivity and selectivity by utilizing the latest FET circuitry with four IF limiters in the frontend of the 5001 and five in the 5003. They both deliver a wide 20 to 20,000Hz power bandwidth while holding distortion down to less than 1%. They feature completely automatic stereo switching with a separation figure of better than 35dB. They allow two speaker systems to be used either independently or simultaneously. Indicative of their unchallenged performance is their refined styling. All controls are arranged for convenient operation. The attractive black window remains black when the power is off, but reveals both dial scales and tuning meter when the power is on. For the creative stereo fan, the JVC 5001 and 5003 are unquestionably the finest medium and high powered receivers available today.

How the SEA System Works

Glance at the two charts appearing on this page. In looking at the ordinary amplifier frequency characteristics where only bass and treble tone controls are provided, you can see how response in all frequency ranges at the low and high levels is clipped off. Compare this chart with the one showing the SEA frequency response characteristics, and the difference is obvious. No clipping occurs in the SEA system. It offers full control of sound in 60, 250, 1,000, 5,000 and 15,000Hz frequency ranges from −10 to +10db. For the first time ever, you have the power to determine the kind of sound you want to hear.



For additional information and a copy of our new full color catalog write Dept. AM:

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Letters

Electronic Crossover Networks

• I would like to mention several advantages for an electronic crossover in addition to the ones mentioned in a recent *Audioclinic* column. The first is also related to the discussion of damping factors. If any element connected in series between an amplifier and loudspeaker has a significant impedance compared to that of the loudspeaker, it will deteriorate the effective damping factor. In the case of a crossover network in the speaker line, this effect occurs near the crossover region and becomes progressively worse as the amplifier "sees" less and less of the loudspeaker load and more of the reactive load of the crossover elements. This is particularly bad if the crossover slope is gradual because the loudspeakers are still radiating significant amounts of power well into their stop band where the effective damping factor is a fraction. I agree with you that the effects of damping-factor changes are often subtle, as is the difference between 0.1% and .01% distortion, but when we have effective damping factors of unity or less, even in a restricted frequency range, I think we may have cause for worry.

Another advantage I believe to be important is that the efficiencies of the midrange and tweeter, which often are inherently relatively high, need not be restricted to that of the woofer through the use of an attenuator (which may also serve to deteriorate the damping factors of the midrange and tweeter). In many low-efficiency loudspeaker systems, the risk of voltage clipping of the amplifier occurs as higher-frequency tones "ride" on high-amplitude low-frequency tones. If the higher frequency is amplified by a separate amplifier, the risk of amplifier clipping is reduced by having a more efficient midrange or tweeter transducer, and/or by the fact that it no longer "rides" on the low-frequency signal. This attribute is even more valuable if the amplifier has poor overload characteristics or recovery from clipping as do several otherwise excellent amplifiers.

Other disadvantages of a passive crossover network overcome to a large extent by the use of an electronic crossover are:

1. Inferior transient response caused by the reactive elements in the crossover.
2. Difficulty in providing an accurate crossover frequency because of the unavailability of precision, high-power network components.
3. Difficulty in providing a well-defined crossover slope because of the frequency-dependent impedance of the loudspeakers.
4. Damping-factor limitation imposed by the resistive component of the elements in series with the loudspeakers (as distinguished from the effect previously described which is due to the reactive component.) This is the limiting factor in the pass-band of the transducer. For example, the d.c. resistance of a coil in series with the woofer might be 0.4 ohms; the effective D.F. is then limited to 10 if the woofer's impedance is 4 ohms. It makes little difference if the output impedance of the amplifier is .01, .001, or one nanohm, the D.F. will be 10 regardless of where the magic damper control on the amplifier is set.

Finally, I would like to comment on the phase relationship between highs and lows. I am not sure whether you meant that phase relationship was unimportant between highs and lows as long as it is maintained in both *stereophonic* channels, or whether you meant the phase change of the high channel with frequency should be the same as the low channel with frequency. If you meant the latter I agree (almost), but if the former I would tend to disagree as follows:

For either type of crossover, electronic or passive, it is possible to provide a flat phase response of 0 degrees; i.e., no time delay of any frequency with respect to any other. In both cases, however, this is possible only with a 6 dB/octave slope. This may be verified by summing the transfer functions of the various sections of the network and checking to see that they add to unity: i.e., the instantaneous sum of the output voltage should equal the input voltage at the same instant for all frequencies. Of course it is assumed that the loudspeakers are phased to the power amplifier properly. Likewise, it can be shown by the investigation of their transfer functions, that 12 dB/octave networks exhibit either: A) speakers out of phase 180 degrees at the crossover frequencies and no time delay of high frequencies with respect to low frequencies; or B) speakers in phase throughout the crossover region, but with a time delay of the high frequencies relative to lower ones.

(Continued on page 63)

"At 7½ ips, the response was within +0.5 db, −2.0 db from 20 to 20,000 Hz. This has never been equalled by any other recorder we have tested."

. . . *Stereo Review*

"So good is the servo control that it has proved extremely difficult in practice to measure any waver of wow or flutter; for quite long intervals the meter drops below the point at which reliable readings are possible . . . Studer and his team have truly produced a tape recorder landmark."

. . . *Audio Record Review*

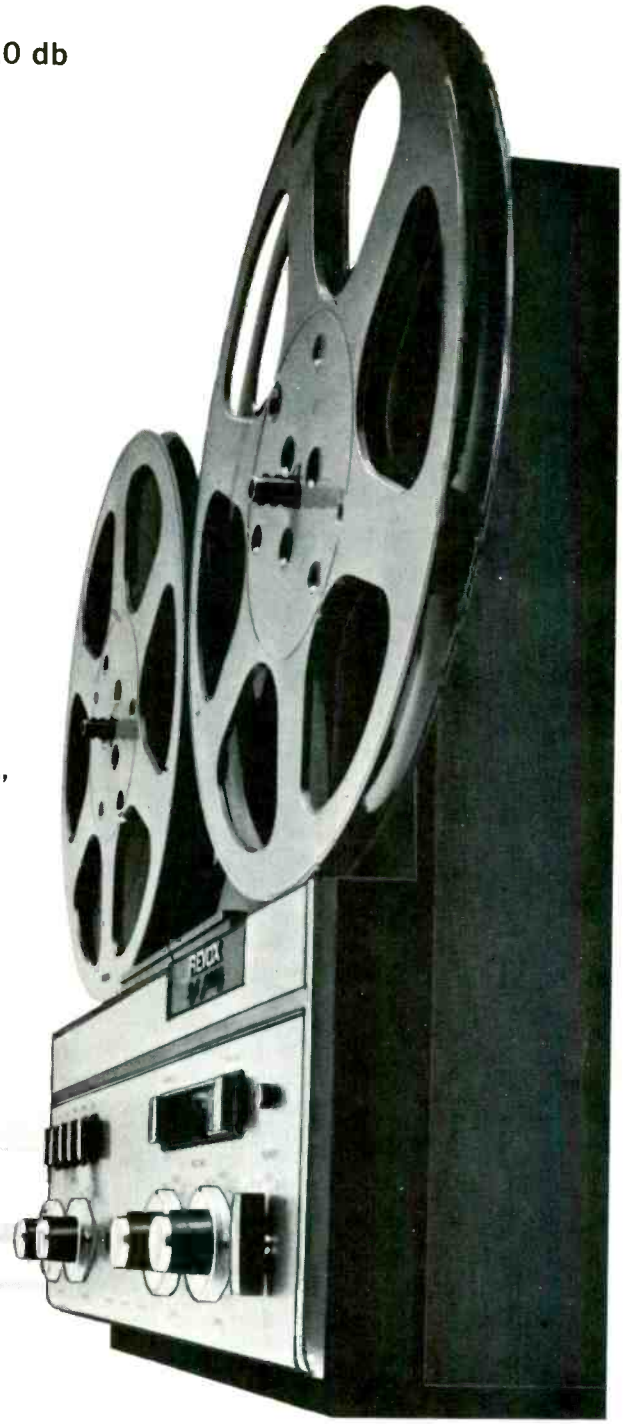
"This recorder is a masterpiece of electronic and mechanical engineering."

. . . *Hi-Fi Sound*

"This is the flattest machine we have ever tested."

. . . *Audio*

This is the REVOX A77 priced from $499.00



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BEHIND THE SCENES

BERT WHYTE

The $$ Crunch in Classical Recording

FROM THE EARLIEST days of high fidelity, classical recordings have been used to demonstrate the quality of the component parts of a music system. The classical record and, later, the classical tape, were the yardsticks we used to measure progress in the field. This was (and is now) not based on snobbishness or any personal bias in favor of classical music over popular music. The simple fact is that classical recordings offer a technical challenge to the performance of a system, while the vast majority of pop recordings are not of much use in this respect.

The pop recording has limited dynamic range. On the order of 25 dB or less, it rarely has any bass response below 50 Hz, and with its dynamics permitting very high-level recording there is usually no problem with signal-to-noise ratio. In these stereo days, the pop record with its multi-mike, many-tracked complexities bears no relation to reality in terms of what you would hear with the same musicians on a live basis. The pop record is a creature of the studio. The stereo perspective is "custom made" to order for directionality and reverberation content. These are some of the reasons why some pop artists who made their reputations on recordings bomb so badly when they venture into the night-club circuit. Shorn of their electronic "crutches," their live performances are but pale shadows of their phonographic magnificence. This is also one of the reasons for the upsurge of interest in microphones with built-in echo facilities and elaborate sound installations in night clubs.

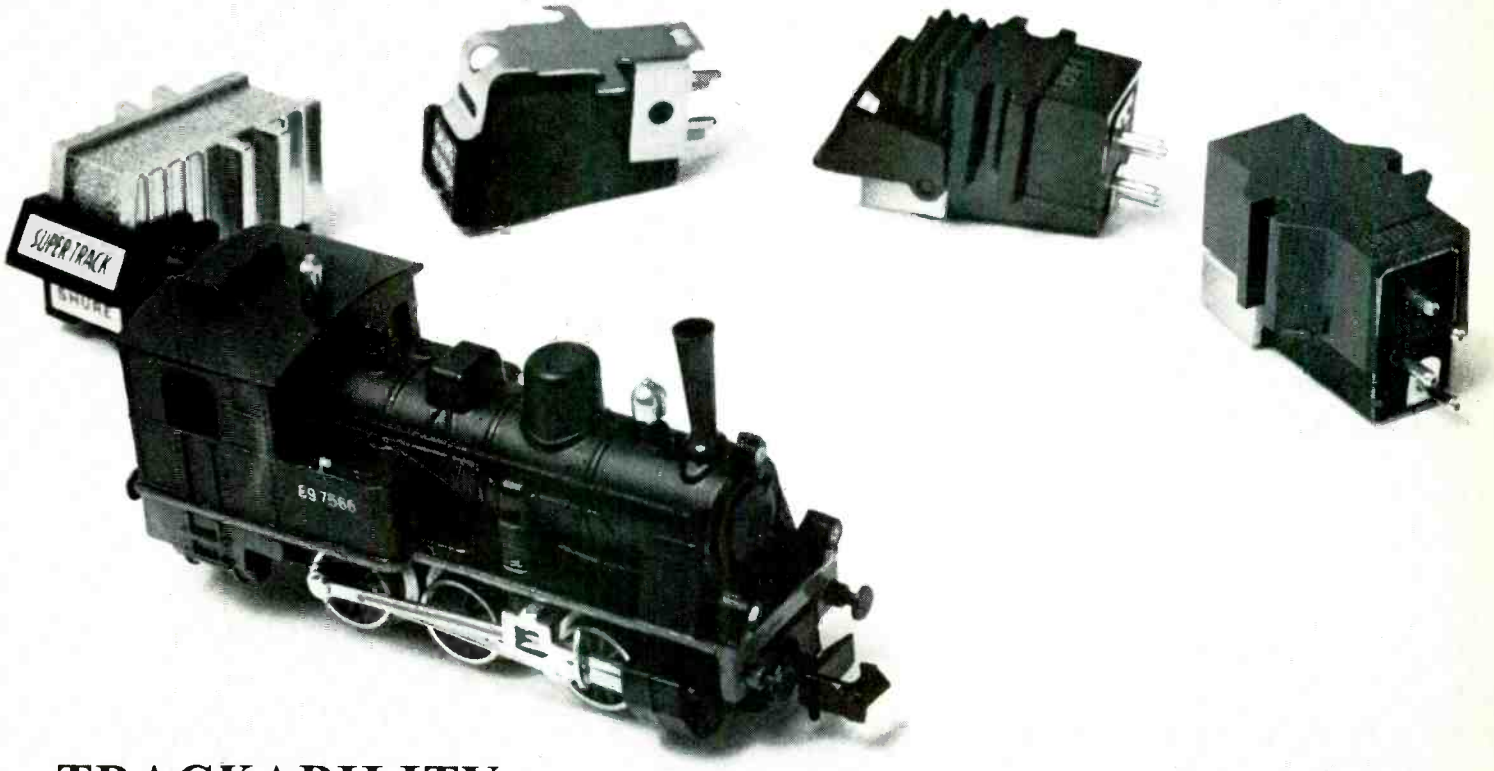
There is little doubt that classical recordings made a significant contribution to the early growth of the hi-fi component market. This in turn, of course, increased the sales of classical records. While all this is true, it must be admitted that the pop record market has always been greater by far than the classical market. As progress continued in the hi-fi field, some of the benefits began filtering down to the "Queen Anne" consoles and the lower-priced phonograph equipment of the mass market. Pop records began to sound better than ever and sales boomed. Couple this with the advent of the "affluent society" and the "youth revolution" and the growth of the pop record market became positively spectacular. For quite a few years the classical record market grew slowly, but steadily, finally reaching a high water mark when, if I remember correctly, it constituted 26 per cent of the total market. From that point there has been a gradual decline. For about the past five or six years the classical market has been more or less static at about 9 to 11 per cent of the total. According to the RIAA, sales in 1969 should be close to a billion dollars. Thus the producers of the classical product will have something on the order of 100 million dollars to share among themselves. This sounds like a lot of money, but most of the classical marketing people I have talked to have bemoaned the slimness of their share. They also were dismayed by the mushrooming competition in the field, the flood of cheap labels, and the sales plateau on which they have been perched for the last few years. In short, they are very unhappy with the state of the classical record market.

Why has all this happened? This is a very complex question, with the answer scattered among many theories and opinions. One holds that it was the members of the "Establishment" who could afford the component hi-fi and who supported the classical market, and that this is no longer true. Another feels that once these people assembled a "basic" classical library, their acquisition of newer and more adventurous repertoire was relatively slow. Still another feels that only the more avid collectors have enough musical erudition to appreciate and want multiple versions of standard classics. This is disputed by a producer who says that a person will buy a second and third version of his favorite work if the successive recordings are demonstrably superior from a technical standpoint. Yet another asks plaintively, "How many Beethoven 5ths can the market absorb?" He is answered by a producer who says, "Everytime we have strayed from the standard repertoire and issued some exotics, it bombed."

The proliferation of new, cheap, classical labels and the spate of reissues is cited for cutting into the "normal" market. The spokesman for one of the big record companies says this could be countered if they could afford to record new versions of the basic repertoire (and even some "offbeat" material) with the big name artists and orchestras, replete with all the latest technical advances. "We are caught in a profit squeeze," he said, "and in this country it is now so expensive to record symphonic material that we must drastically curtail such activity." Other producers I contacted voiced the same sentiments: that symphonic recording in the United States is now almost prohibitively expensive. One candid gentleman said that if it were not for certain grants and the aid of wealthy people, even less symphonic recording would take place. This matter of recording costs has been an issue for some years now, and is largely responsible for so much symphonic recording being done abroad, where costs are considerably lower than in the U.S. In view of some of the opinions expressed, one wonders whether lower recording costs in this country would substantially stimulate the classical market. Many feel that it would. But in any case, there is a unanimous condemnation of the cost problem.

What I have recently been told will not make these classical record producers any happier. The American Federation of Musicians has decided to ask for a "substantial" increase in the symphonic recording rate; it is said that negotiations are already underway. Will this be the last straw? Will there be a strike, or an embargo on recording? Will the flow of recording to Europe increase dramatically? I wish I knew the answers to these questions. However, I have made symphonic recordings in this country and in Europe and am familiar with costs. Let me give you an idea of the amount of money required to record a typical symphony, both here and abroad.

Let us assume we are recording a major symphony orchestra. The work to be recorded can be accomplished with perhaps 85 musicians, but it is common practice to augment the strings so that in this case we have an even 100 musicians. The basic union rate is $53.65 per man for a two-hour session, thus we have an initial outlay of $5,365.00. However, the amount of actual music you can put on tape in those two hours is restricted to 40 minutes. Since many symphonic works are longer than 40 minutes, you need more recording time. Even if the work was



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only of *41-minutes* duration, that one minute over the allowable recording time must be paid for by going into a half-hour overtime, which for 100 men is a matter of $1,341.00. In that half-hour you are allowed to record 20 minutes of music. Theoretically, then, you could record an hour of music with one session and a half-hour of overtime. In practice, this would be a virtual impossibility. It is rarely possible to record a symphony in two sessions with a half to an hour overtime. Usually it takes three sessions and perhaps some overtime. If you are unfortunate enough to run into artistic or technical difficulties, the recording might take four or five sessions. When this happens and you are the recording director, you have the time hanging over your head like some giant taxi meter which inexorably ticks away the dollars.

To keep sessions to a minimum, here is the usual procedure: The director of artists and repertoire has decided what he would like to record with this particular orchestra and conductor. He clears his choice with the marketing executives in his company and then consults with the conductor *before* the start of a new symphony season. If all is agreeable, the conductor will program the work to be recorded. Sometime during the season, the conductor will rehearse the work to be recorded. He will beg, borrow or steal all the rehearsal time he can. Then the work will be played at three, perhaps even four regular concerts. At this point, when presumably the orchestra really has this work down pat, the recording team moves in and usually records the work the day after the last concert. In this fashion the work usually gets recorded within three sessions.

With our hypothetical symphony this would total $16,095.00. If the orchestra is located away from the recording company's home base there are transportation and expenses for the recording crew. If the hall in which the orchestra gives its concerts is not suitable for recording, you must rent another hall at from $500 to $1,500. The score of your work may call for instruments not normally owned by the orchestra to be rented. If you are recording an oratorio or a Beethoven 9th Symphony—anything that requires a large chorus—you may have to rent chairs. If the work you are recording is not in the public domain you will have to pay the composer's publishing company a royalty, as well as rent or buy scores of the work. The musicians union also requires a certain amount of money to be paid into what is known as the "performance fund," the proceeds of which are for the aid of indigent musicians. The conductor has a royalty arrangement, which usually is 5 per cent of the *retail list price* of the record (or tape) and he may or may not require an advance on his royalty. For some of the really "big shots," the financial terms are more attractive. Most contracts with a conductor stipulate that the recording company must recover the costs of the recording before the royalty payments can commence.

What with one thing and another, you can readily see that to record a typical symphony would run from an almost impossibly low $11,000 to an average $15,0000 to $18,000, to a not uncommon $20,000. Needless to say, the costs for a really big project like a Mahler 8th Symphony and for many operas can be astronomical.

Now let us contrast these costs with a typical symphonic recording in London, using an orchestra of the calibre of the London Symphony or the London Philharmonic. The British musicians have a rather complicated payment in which rank and file members of the orchestra get one set fee; what they call "second principals" get a higher fee, and "first principals" (equivalent to our desk men) get a still higher fee. They also have what is called a "management fee" of 12½ per cent. It all adds up to 700 pounds or about $1,680 for a three-hour session, and unless they have changed recently, within the session you can put 40 minutes of music on tape. Theoretically, some "cheap and dirty" label could record a 35-40 minute LP for about $2,000.

It is not likely to happen in this case for none of the London orchestras would ally themselves with such a label. They prefer to contract for a number of recordings and book the sessions in blocks. The London orchestras do so much recording that the men are fabulous sight readers, and they can cope fairly rapidly with unknown scores. It is rarely possible to have the same arrangement of performance before recording as in this country. For one thing, most recording is not done during the regular season. For another, specific condctors usually are contracted for specific works and it is conceivable that in a block of sessions you may record with four or five different conductors. In any case, you can record most symphonic LPs within three sessions, which would cost a little over $5,000. Most of the "extras" I outlined for an American recording session apply equally well here, except in most cases the costs are less in London. One striking example: the acoustically famous Walthamstow Hall used to rent about $60. Perhaps it is more now, but I would bet the increase would be trifling. Of course, transportation and living expenses for the recording crew are going to be higher than in the U.S., but it isn't all that expensive anymore to fly across the Atlantic. All costs considered, the total for an LP would average about $6500 to $7000. Obviously, it is possible to make at least two, and oftentimes three recordings in London for the cost of one in the United States. This economy is not lost on American producers, which is why there is so much recording activity in London. I should add that recording costs in several European countries are substantially less than in London.

No matter what the reasons advanced by the many recording people I spoke to, it is obvious that the classical record market is not what many people think it should be. Dollar volume has increased each year, but the percentage of the total market is static. It is sheer conjecture whether any of the remedial measures that have been suggested would have any salutory effect on the market. Looming ominously in the near future is the oft-quoted statistic that half the population of the country will be under 25 years of age. This obviously pop-music oriented group is likely to cut even deeper into the total record market. The faint hope of many is that, as maturity comes to many of the young, they will "discover" classical music. Perhaps so, but I think it will take some pretty nifty promotion, on a level that the young can "dig," to encourage this trend.

In any case, things are bad enough without the ill-timed quest of the musicians union for an increase in recording rates. I bow to no one in my admiration for the skills of our symphonic musicians. Theirs is a most demanding profession and they work very hard. But we must remember that they receive a regular salary for their concert duties. Recording money is strictly augmentary, a bonus whose size is dependent on how much their orchestra records. At this critical point in the classical record business the musicians could help the business and themselves by reducing the recording rate, not asking for an increase. What sense does it make to drive the rate so high that no one wants to record, or at least severely limits the amount of recording? Surely, many reduced-rate sessions are better than a few high-priced sessions. Let us hope wisdom prevails, or classical recording in this country will become moribund. Æ

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Classical Record Reviews

Edward Tatnall Canby

AUDIO MUSIC REVIEW

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Revaluing the Twentieth Century

Boulez Conducts Stravinsky Firebird Suite, Bartók Music for Strings, Percussion, and Celesta. BBC Symphony Orch. **Columbia MS 7206 stereo** ($5.95)

My ears perk up whenever a Bartók or early-Stravinsky recording appears. Both composers' works, ultra-modern and at the same time full of traditional Romanticism, are subject to astonishingly varying emphasis in the interpretation. Moreover, there are often quite different versions, to begin with. This applies to both works on this dynamic new recording the young French conductor-composer whose touch seems to transform almost any music he works on.

The Firebird music exists in numerous formats. There is the original ballet, the much-reduced orchestral suite form, the original thick scoring and the Stravinsky-produced revisions of much later years. As an early work it is full of late-Romantic effects, but also of astonishing modernisms. Boulez, paradoxically, chooses here the original suite, in the older and fuller scoring, then proceeds to make it sound newer. He rips along, playing down the great Romantic climaxes that once made Firebird the best-loved "modern" piece among our parents and grandparents, building up the modern instrumental effects and bizarre harmonies. This version, moreover, leaves out two familiar numbers, the Berceuse and the long-winded (I always thought) Finale — though that ending was, if I am right, a later addition by Stravinsky.

All in all, this is a very novel sort of Firebird and a worthwhile one to add to any Firebird collection. Be sure to try, also, Stravinsky's own complete ballet version, the one with the strange and unfamiliar connective tissue that carries on the stage action between the big set pieces. Oddly, the most modern-sounding music in the work is this in-between material, left out of the Suites. Stravinsky composed it in later years, to join up the earlier segments.

As for Bartók's 1937 masterpiece of controlled fury, it also comes in two versions, one for single strings, a "chamber" work, and the other with string orchestra. Boulez, using the big version, once more manages to combine elements of both. The taut, disciplined, rapid playing de-emphasizes the Romantic elements that are, as always, still latent, thereby giving the piece a more chamber-like sound than in other more opulent orchestral versions.

As Boulez says, the composer proposes, the listener — the performer — disposes. This is only one way to do the music. Try RCA's early-stereo Reiner version for a wholly different sound, for example. But the Boulez approach is a valuable one, and particularly in recorded form—this being one of the most horribly thorny scores ever to face up to the microphone and tape recorder. Boulez definitely helps with its major problems—the long, ultra-pianissimo opening for murmuring strings, where the ear is unable to "set level" (Boulez plays it louder and faster than many others), the much-delayed explosive entrance of full percussion, piano, xylophone and celesta, then the wispy middle movement with its almost inaudible xylophone pings, down dangerously near the "mud" level and finally, the sudden violence of the racing last movement, back to maximum level and maximum transient explosiveness.

Some score! Worth having a dozen versions in your record library just to see how differently the performers, on the one hand, and the engineers, on the other, have faced up to Bartók's challenging "proposals."

Performances: A— *Sound:* A—

Stravinsky: The Rite of Spring; Fireworks. Chicago Symphony, Ozawa. **RCA Victor LSC 3026 stereo** ($5.98)

Here's another famous early 20th century work that is peculiarly subject to changing interpretations — since it, too, combines the radically new with many elements of traditional symphonic music, as we see it today. Most past versions of the piece are on the monumental side, heavily stressing the extreme dissonance, the ponderous savagery of the famed Stravinsky pagan rites. In its own day, and until recently, the violent clashes of sound on sound in this score were unbelievable to many ears, and to the performing musicians themselves. And that was what we heard—we could almost sense the players' own shock as grating clashes hurtled forth from their surprised ensemble.

Now, those dissonances are not only familiar but even a bit old fashioned. So two instruments play along together in minor seconds, curdlingly dissonant? Now, they do it with the utmost calm, for the effect is easy and familiar. We can hear that, too.

The youngish, long-haired Japanese conductor, Seiji Osawa, is very much a part of this new attitude. His "Sacre" is almost casual in its neatly tailored treatment of the well known dissonance. No longer is there that great, hideous groaning and grunting, no longer the sense of shock communicated from the musicians themselves. Instead, we have an almost Mozartean classicism, an impeccably light, accurate, polished playing, moving rapidly along, clean-cut instead of rough hewn. There is, even, a bit of the Japanese in it. Chicago!! Who'd a' thunk it.

Appropriately, the dissonant texture of the piece is not a bit diminished. It is merely cleaner, more practiced, perhaps even more effective for being taken for granted. The RCA recording is somehow related to all this, a clean, concentrated sound on the dead side, almost intimate.

The dividend piece, the short early Fireworks, comes first, at the beginning of Side 1. Good. It would be an anti-climax coming last.

Performance: B+ *Sound:* B+

(Continued on page 56)

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Tape Guide

HERMAN BURSTEIN

Microphone Wind Screen

Q. A few months ago I purchased a battery-operated tape recorder, principally for foreign-language practice. Somewhat to my surprise, this little machine has proved to be adequate for another hobby of mine, which is recording of sound of trains. However, the microphone is quite susceptible to wind noises. Can you recommend a microphone which is reasonably immune to wind noise?—Ralph Brunson, Lubbock, Texas.

A. Most manufacturers of microphones make units equipped with a screen to diminish wind noise. Also, some furnish a screen as an accessory. I cannot recommend a specific microphone. I suggest that you write to several microphone manufacturers for recommendations as to their respective units which can meet your needs, at a price within the range you care to spend.

High-Speed Duplication

Q. There has long been a question that I have wondered about. In recording from pre-recorded tapes made at 3.75 ips, would there be a decisive advantage to play this tape at 7.5 ips and record from it at this same speed? This is apart from the shorter time to duplicate the tape. Of course the duplication would be done with two tape machines of comparable quality.—James W. Larsen, Camp Lejeune, N.C.

A. I do not know of any decisive advantage in copying a 3.75-ips tape at 7.5 ips, other than the saving in time. Rather, there is a question whether this produces as good a duplicate tape as copying at the 3.75-ips speed. The answer is not clear, and quite a few, based on experience, claim that the results are about as good or nearly as good when copying at 7.5 ips as when copying at 3.75 ips (assuming, of course one is dealing with a tape originally recorded at 3.75 ips).

Theoretically, there is a disadvantage in copying at 7.5 ips. When a 3.75-ips tape is sped up to 7.5 ips, all frequencies are doubled. Thus a 12,000-Hz frequency becomes a 24,000-Hz one. The question then is whether the electronics of the playback and recording machines can handle the highest (stepped up) frequencies. There is also the increased possibility of beating between audio frequencies and the bias frequency. Ideally, the bias frequency should be at least 5 times as great as the highest audio frequency. But if all audio frequencies are doubled, there is less apt to be such a margin, with a resulting increase in the likelihood of "beating," manifesting as noise. Finally, there is increased possibility of tape distortion, owing to treble emphasis in the recording process being applied to stepped-up frequencies of considerable magnitude.

The best answer you can obtain is through practical experience. Try copying at both speeds on the same reel of duplicate tape, and note whether there is an audible difference.

Excessive Noise Level?

Q. With the playback gain control set at maximum, my tape machine produces what seems to me to be an excessive amount of noise. How can I check this?—Richard Firtik, Mountain View, Calif.

A. Some tape machines aim at maximum output of as little as about 0.5 volt, while others go as high as about 5 volts—a difference of some 20 dB. And, everything else being the same, the 5-volt machine will also produce 20 dB more noise. Possibly yours is a high-output machine, with a signal-to-noise ratio that is nevertheless satisfactory. I suggest you do the following. Obtain a pre-recorded tape or record a tape on your machine. Play it back on your machine and note the noise level. Play it back on a comparison machine (perhaps a friend's) that you know to be of high quality. If playback noise is about the same for each machine, with the audio signal at equal levels, then your machine's signal-to-noise ratio would appear satisfactory.

Monitoring the Tape

Q. I make live recordings and have wondered how I may monitor my tapes during recording.—John Eshia, New Britain, Conn.

A. You must have a tape recorder designed for monitoring, that is, one with separate record and playback heads and also with separate record and playback amplifiers, so that you can simultaneously record the tape and play it back. Further, you must have an amplifier with a monitoring facility, so that it can switch between the incoming signal (which is also being fed by the amplifier to the tape recorder) and the tape recorder's playback signal. In the absence of a monitoring facility in your amplifier, you can monitor directly from the tape recorder's output jack, provided that this is of low impedance. You can connect high-impedance headphones to this jack. Or you can use a low-impedance headphone in conjunction with a step-up transformer in order to improve the match between the headphone and the tape recorder output.

Setting Bias

Q. I would appreciate any comments you might have on the proper setting of bias in a tape recorder. At 3.75 ips I feed in a 1000-Hz signal at 15 dB below 0 VU level. Using a VTVM, I read the playback output at my speaker terminal. If 0 VU = 100, then the maximum output as I adjust bias is at 70, using a high-quality tape. But then the sound comes out definitely tinny. However, for the tape I am using, the instruction book for my tape recorder says I should set bias to read 0 VU in playback. But I cannot reach 0 VU. I would also like to know if there is any way that I can measure distortion. While I do not have distortion-measuring equipment, if I knew where distortion was lowest as I adjust bias, this would be most helpful.—Dennis S. Furbush, Flushing, N. Y.

A. In the better tape machines it is often the practice to adjust bias until maximum output is achieved at a frequency such as 1000 or 500 Hz, depending on tape speed (keep in mind that a 1000-Hz frequency at 7.5 ips has the same *wavelength* as 500 Hz at 3.75 ips); and then *increase* bias so the output drops about ½ dB. It would seem, therefore, that you should increase bias past the point where you set it.

To measure distortion—usually it is harmonic distortion that is measured in a tape recorder—you need a 400-Hz signal source and a harmonic distortion meter. In general terms, bias increase causes distortion to drop at first, but eventually to rise. The bias employed in a tape machine usually represents a compromise among conflicting requirements of extended treble response (calling for reduced bias), low distortion (calling for increased bias), and low noise. At speeds of 7.5 and 3.75 ips. it is usually necessary to use less bias than would result in minimum distortion, thereby permitting extended treble response to be attained. Æ

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EDITOR'S REVIEW

Classical Music for the Rock Set

Mahler with psychedelic lights! A recital on the Baldwin Electronic Concert Grand Piano! That's the way it was last month in Philadelphia and New York City, respectively.

In Philadelphia's *Electric Factory*, a local discotheque, Mahler's Symphony No. 3 premiered with psychedelic lighting. The orchestra, baritone, choral groups, and dancers wore black turtleneck shirts and slacks. The presentation had a two-fold purpose: to introduce classical music to young people in an environment that isn't forbidding (. . . "many of them would be hesitant to go to the Academy . . ."), and to allow performers to feel exhilarated by what they play. In New York City's *Fillmore East Auditorium*, the *New York Times* reported that Lorin Hollander played a recital (Bach, Prokofiev, Ravel, Debussy, and Schubert) on a Baldwin Electronic Concert Grand Piano. Mr. Hollander wore a sleeveless leather coat of mod cut, with black sweater and pants. The decision to hold the concert in "the very lair of rock" was apparently made because "young people are reluctant these days to go to the marble mountain at *Lincoln Center*."

As the man on the video tube says, "Very Interesting."

Cassette Concept Strengthened

In a surprise move, RCA—who, with the assistance of Lear Jet and the Ford Motor Company, introduced eight-track stereo cartridges — announced that they will now market pre-recorded cassettes. Columbia Records followed on the heels of this announcement with a similar statement. Thus, the last two major holdouts in the pre-recorded cassette field joined the fold.

This doesn't indicate that eight-track stereo cartridge sales have slipped. In truth, they are skyrocketing. It simply indicates that RCA and Columbia Records want a piece of the action in the pre-recorded cassette field, which is also enjoying great sales. Furthermore, RCA's home entertainment division, the consumer equipment manufacturing arm of the company, will find easier sledding for its cassette machines when the company backs the concept with its pre-recorded cartridges.

Wild Sounds

Multi-Vider, a $244.50 four-octave electronic device for wind instruments, developed by the Conn Band Instrument Company, has assisted in producing some of the wild sounds heard in some motion pictures, pop records, and TV commercials, as well as on some "live" club dates. (See photo of trombonist Buddy Morrow using the device.)

With the use of a pushbutton control and dynamic volume control, wind-instrument musicians can get, in addition to the note they play, sub-bass, bass, and soprano octaves that can be used separately or in any combination. The new musical sounds and effects it provides was used by Don Ellis (trumpet) during the final chase scene in "Rosemary's Baby" and in his LP album, "Shock Treatment," and by Frank Rosolino (trombone) in the sound track of "In Cold Blood," and by West-Coaster Tommy Scott on five of eight cuts on his new album "Honeysuckle Breeze" (Impulse-ABC Records). The list of musicians using the Multi-Vider for electronic wind music is said to be growing. Soon you won't be able to tell a bassoon from a clarinet on sub-bass octave.

Show-Time News

England's *Audio Fair* will be displaced by a new show, the *International Audio and Photo-Cine Fairs*. As the name indicates, this is to be a joint venture designed to appeal to both hi-fi enthusiasts and photography hobbyists. Sounds like a natural, since so many hi-fi buffs are also camera "bugs." If you're London-bound in the fall, the show will be held from October 16-21 in the National Hall, Olympia, London.

The third annual *Consumer Electronics Show* for the industry will be held June 15-18 at the New York Hilton and Americana Hotels in New York City.

A.P.S.

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PHOTOGRAPH BY FRANZ EDSON

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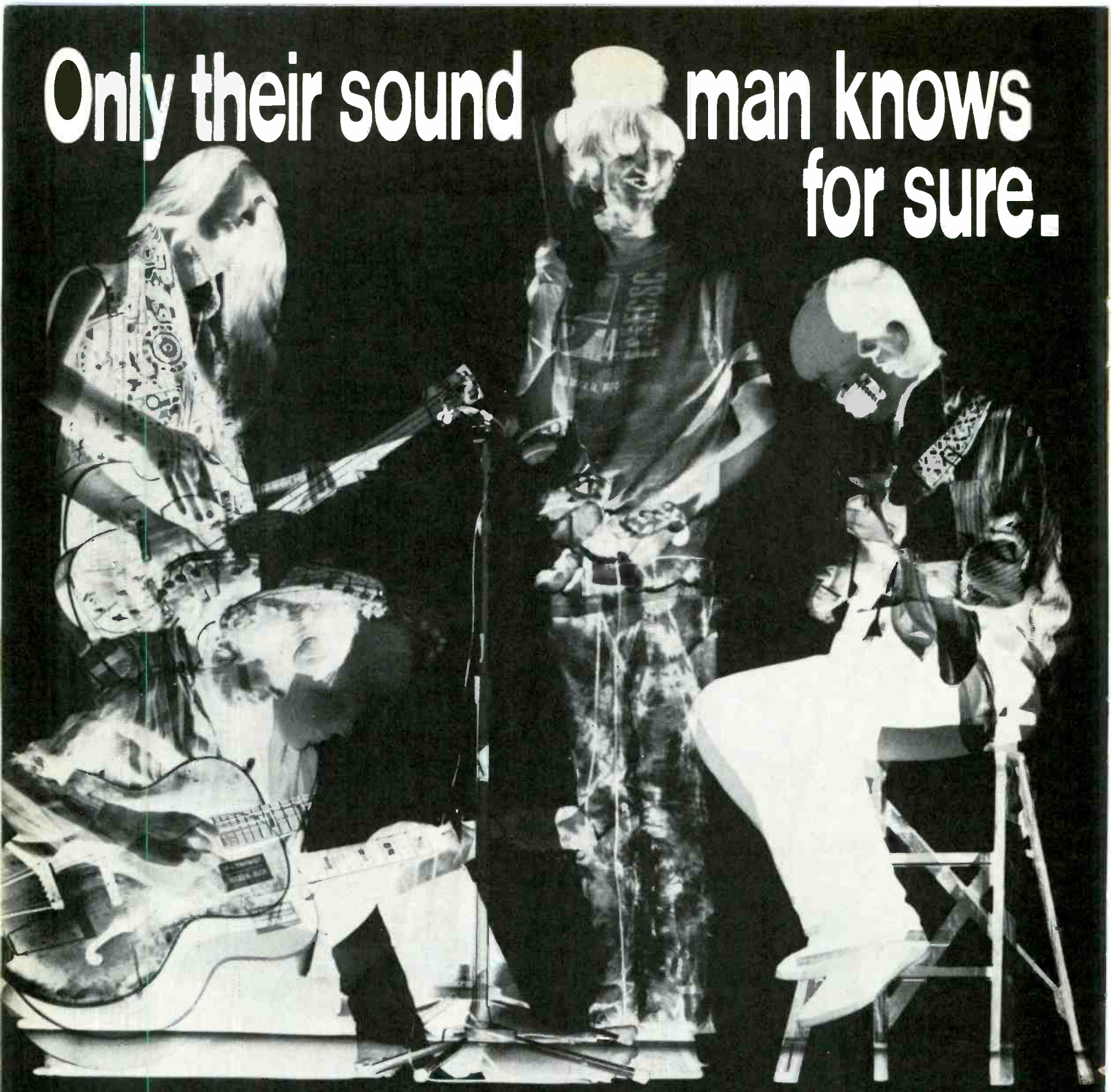

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a "pop" recording session

JOHN M. WORAM

Singer Peggy March visited the RCA Victor Studios in New York City to record a new song, called Purple Hat. Here is a description of the session—from the point of view of the Recording Engineer.

A WEEK or so before the first recording session of a new song with singer Peggy March, a series of informal meetings were held with the Producer, Pierre Maheu, and Composer-Arranger Holdridge to map out the various recording details. Discussed were: choice of studio, tape format, placement of musicians, and selection of microphones.

It was decided right at the beginning to record on 8-track one-inch magnetic tape. This might seem extravagant considering that the final product, although richly orchestrated, contained no special effects that might demand multi-track techniques. However, the multi-track recorder is turning out to be a valuable tool for even the most straightforward of sessions.

At best, a phonograph record is a simulation of the real thing—a live performance. And, as good as records have become, they still lack some of the ingredients of the live performance. To help compensate for these missing ingredients, the record must try to achieve a level of excellence, within its accepted limitations, that might not be realizable at an actual performance. The record's medium is sound, and sound *only*. There is no visual stimulation, nor is there that two-way communication between artist and audience that contributes so much to the live performance's atmosphere. The record audience sits at home, separated by time and space from the artist, and with no visual or atmospheric stimulation, concentrates on one thing: How does it sound? Mistakes that might pass unnoticed in the concert hall will be noticed after a few playings of a disc at home.

At the concert hall, it is also possible that you may not hear the proper proportion of, say, drums, and yet due to the stimulation of the actual performance, you may not actually notice the deficiency until

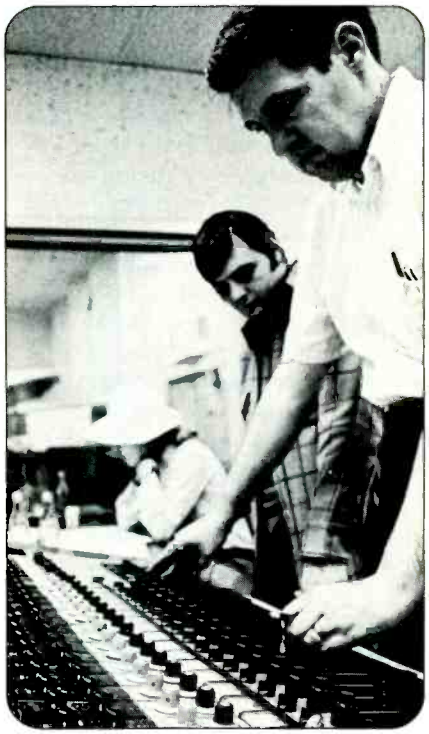

Fig. 1—The author at the control console, with producer Pierre Maheu at his right, and singer Peggy March in the background studying the score.

the man in the next seat (who happens to be a drum connoisseur) points it out to you during the intermission. By then it is too late, and with apologies to drummers everywhere, it probably didn't affect your total enjoyment that much anyway. But when you play a record at home, you expect to be able to hear the drums—and every other instrument—at all times. Not too loud, of course, but in the proper balance despite the fact that the sound is now coming from two speakers, rather than from a three-dimensional orchestra spread across a large stage. And in addition to a good balance within the orchestra, the whole orchestra must never overpower, nor be overpowered by the soloist.

Which brings us to the orchestration for the Peggy March session, and, I hope, a passable defense of multi-track recording. The finished product will contain, in addition to the voice of Miss March, the sound of:

16 violins	1 piccolo
4 violas	2 guitars
6 celli	1 piano
4 french horns	1 Fender bass
4 trumpets	1 drums
4 trombones	1 tambourine
1 flute	

It would be possible to bring all these musicians into the studio, set up a couple of microphones, and record the entire ensemble at one time. In the past, all recording was done in this manner. However, this technique leaves little margin for error or for changes in judgment. If, on listening to a reference lacquer at a relatively peaceful after-session review meeting, it is found that more drums are needed, there is nothing much that can be done about it. One is more or less stuck with whatever balance (or lack of it) was achieved during the actual session. Also, there would be no such thing as adding a little more reverberation to the violins only.

During such a session there would be little that could be done in the way of selective equalization, limiting, and so forth, since one microphone picks up so many instrument families. One obvious improvement is the multiple-microphone technique. If many microphones are used at fairly close range, the Recording Engineer can exercise greater control over the sound of the various instruments. The violin microphones alone can be fed into

an echo chamber, the drum microphones through a limiter, and so on. And since the "Universal Microphone" is still waiting to be invented, each instrument can be recorded with the type of microphone thought best suited for it.

And now we add multi-track recording. With a modern 8-track (or more) recorder, we can put each set, or type of instrument on its own separate track. Now, long after the session is over, we can balance the tracks, listen, and if we care to, rebalance. In re-mixing later, reverberation can be added to a section, and then removed if it is not satisfactory. In short, many decisions that had to be made irrevocably during the actual recording session can now be deferred. Thus the multi-track technique becomes a valuable tool for almost any type of session.

Some may say that it is just a sophisticated cop-out for Engineers who can't get a good mix during the tension of a session. No doubt it works out this way sometimes, but to ignore its obvious advantages because of an occasional misuse is unrealistic. Anyone want to fly with an airline that passes off radar as a gimmick for pilots who don't know their way around foggy skies?

Multi-track recording is here to stay, of course, and the only question that has not yet been finally answered is: How multi shall we eventually get? For the Peggy March session the answer was 8 tracks.

After going over the score with composer-arranger Holdridge, the following track layout was worked out:

1. Vocalist
2. Lead Guitar
3. Rhythm Guitar & Piano
4. Drums, Tambourine
5. Fender Bass
6. Brass Section
7. String Section
8. Brass & Strings, doubled

It might seem a little unbalanced to allot one track to one guitar while putting an entire string section on another. However, tracks are rarely assigned to achieve a numerical balance. Rather, different types of sounds are assigned to their own respective tracks. The lead guitar—an important part of the score—is put on its own track. The subordinate Rhythm Guitar and Piano are placed together on one track. The Fender Bass could be placed on a track with, say, the drums, but since a separate track was available, it was used so that later on (during remixing to two tracks for stereo records) the Bass could be individually treated. On some high-level passages, the lower notes of the Fender Bass can cause excessive vertical groove excursion when a stereo disc is made. This happens in tape-to-disc transfer when the bass is put on either the extreme right or left side. The problem may be solved mechanically by putting the bass equally on both tracks, with the result that the bass sounds as though it is dead center, the usual position for the soloist, and somewhat of an artistic compromise. To solve this problem, the bass track is first fed through a dividing network having a crossover frequency in the neighborhood of middle C (261.6 Hz). During remix, the section below C is fed in equal proportion to both sides. The above-C portion is fed to one side only—the side from which the bass is to seem to originate.

The above-C portion contains the overtones and the instrument's string noises. Although these sounds contain relatively little volume, the ear is so distracted by them, that the below-C portion coming from the other speaker is no longer consciously heard. The ear focuses on that below-C portion originating from the speaker containing the additional above-C sounds. Although most of the bass signal is on both sides of the groove, thereby minimizing vertical groove excursion on the disc, the ear "thinks" the bass is coming only from one side, thus satisfying artistic requirements. Of course, this treatment can only be used if the bass has been recorded on its own track.

Before going further, we can now point out another advantage of the multi-track process. If musical considerations permit, we do not have to record all the instruments simultaneously. Theoretically, we *could* record one track at a time. However, this would remove all sense of spontaneity from the finished product. A common practice is to divide a song, orchestrally, in two. On the first session, the rhythm or basic tracks are recorded. Later on, during a so-called "Sweetening Session," the strings, brass, and special effects (if any) are added. On the Peggy March session the music was divided using the following basic tracks:

1. Peggy
2. Lead Guitar
3. Rhythm Guitar and Piano
4. Drums, Tambourine
5. Fender Bass

Tracks 6, 7, and 8 were enumerated earlier.

Fig. 2—Conductor-composer Lee Holdridge and a few members of the rhythm section are shown here amid the usual clutter of cables, booms, and amplifiers.

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2 This is also an 8 input, 3 track remix console. Each of the 8 input positions has the same function controls as the 14 live input positions except that the output selector switch panel is limited to three positions. One position is for monaural and the other two for stereo. The monaural output also drives a stereo pan pot. A fourth output can be ordered to drive a second stereo pan pot and facilitate mixing down from 8 track to 4 track. Each of the 3 or 4 output tracks has its own internal and external echo-send and return controls and meter as in the live recording section of the "Three in One" Console. This remix console allows simultanous remixes with Eq. and Echo during live recording and playback for sample mix and monitor purposes.

3 This is also a self-contained recording studio in one package, incorporating these built-in features and functions; Four 120 Watt per channel solid state monitor and playback power amplifiers, Eleven reverb systems, Langevin Graphic Equalizer with special effects switching panel, Playback and monitor control module, Talkback, Slating, Cueing, Special Effects, and Test Tone circuits, plus optional tape recorder direction and Master/Sync. remote controls, patch panel, compressors, and limiters. All inputs and outputs are terminated on a rear mounted Cannon Connector panel.

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Source	Microphone	Model	Type
Peggy March	1 Neumann	67	Condenser
Lead Guitar	1 Shure	546	Dynamic
Rhythm Guitar	1 Shure	546	Dynamic
Piano	2 Sennheiser	404	Condenser
Drums	1 Neumann	56	Condenser
	1 Neumann	67	Condenser
Bass Drum	1 Electro-Voice	RE-15	Dynamic
Tambourine	1 Sennheiser	421	Dynamic
Fender Bass	None (direct pickup off amplifier's Ext. Ampl. output jack through matching transformer to 150-ohm mic line).		

Microphone selection turned out to be a combination of advance selection and on-the-spot changes. By the time we were into the final takes, the microphone layout was as outlined above.

This is certainly not a universal microphone list. It's just a catalog of what worked for us on this particular session.

As can be seen from the photos, baffles were used around each instrument to minimize "leakage" from one instrument into the microphone that's in front of another. For further control, the vocalist was "locked up" in an isolation booth to permit the almost total isolation of her track. It is often necessary during re-mixing to raise the level of the soloist's track so that she is not drowned out by the full orchestra. If, during recording, her microphone has picked up some of the sounds of the accompanists, then as her track is raised during the re-mix, the accompaniment leaking into her microphone comes up too. Not much of course, but often enough to change the overall sound quality.

In the isolation booth, the vocalist can barely hear the orchestra, and they can't hear her at all, which is sort of a hang-up if you're trying to accompany someone. So-o-o, everybody gets earphones. In the Control Room, we combine all the microphones into the Earphone Monitor Circuit. Now our soloist can hear the band, they can hear her, the microphones "hear" only their assigned instruments, and everyone's relatively happy. After a few "takes" we get our "Basic" tracks recorded to everyone's satisfaction. The musicians are dismissed and the Recording Engineer and his assistant, the Technician, are left to "tear down" the microphones and wrap up the cables.

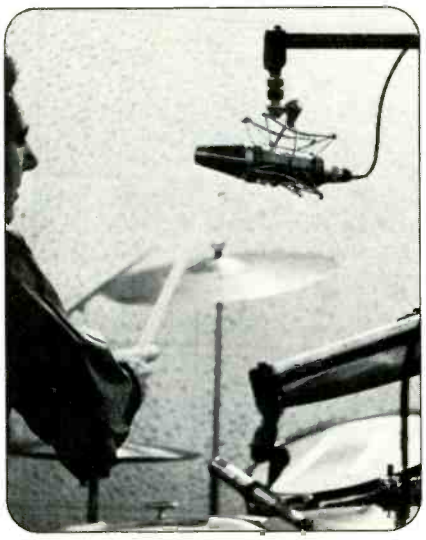
The next step takes place a few days later when the String and Brass players come in for the "Sweetening Session." The set-up is:

Track 6	
Instruments	Microphones
2 French Horns	2 Sennheiser 421
2 Trumpets	2 Shure 546
2 Trombones	2 Electro-Voice RE-15
1 Flute	1 Neumann 67
1 Piccolo	1 Neumann 67

Track 7	
Instruments	Microphones
8 Violins	4 Neumann 56
2 Violas	1 Neumann 56
3 Celli	2 RCA 77 DX

Once again the earphones come out and the basic tracks are played back to the musicians in the studio. On the sweetening session, the so-called Sel-Sync technique is used. In this process, the previously recorded basic tracks are played back using the first five tracks of the Record Head Stack, rather than the usual Playback Head. While playing back tracks 1 to 5 over the Record Head, tracks 6 & 7 of the same Record Head record the Brass and Strings. Thus the Head stack is performing a dual function. The reason? To keep the new "sweetening" tracks in-sync on the tape with the basics. Since the regular Playback Head is a few inches removed from the Record Head, there is a slight delay from the time a signal is recorded until it reaches the Playback Head. If the new tracks are recorded in time with the old tracks (as monitored from the Playback Head) all new material will go on the tape a few inches removed from the corresponding basic tracks, hence the out-of-sync situation. By monitoring from the Record Head, the new tracks are recorded physically in-sync with the old.

Fig. 3—Al Rogers on drums. A Neumann model 67 is used here over the cymbals, with a Neumann model 56 to capture snare-drum sounds.



Of course it's a good idea to make sure the Record function on the previously recorded tracks has been turned off before the "Record" button is pushed, since a lot of otherwise placid people get very emotional if the basics are erased (no matter how neatly) during a Sweetening Session.

Anyway, we managed to get tracks 6 and 7 recorded in-sync, and without any disasters. These tracks were now also switched to the Sel-Sync position and fed back to the musicians, who re-played their parts in time with tracks 6 and 7. This time the entire Brass and String sections were combined onto Track 8, giving us a final product containing one track of Brass, one track of Strings, and one track with a new combined Brass and String Section. This double track enables us to get the effect of a much larger Brass and String section than was actually used. And for stereo, it is possible to achieve a large overall Brass/String sound and also put occasional directional emphasis on either Brass or Strings, as required.

A few days later, the complete 8-track tape was "mixed down" to a single-track ¼" tape, which will be used for tape-to-disc transfer to a 45 RPM record. A similar two-track version may also be made if it is decided to include the song in a future stereo LP album. This "Mix-Down" process, often quite involved, will be covered next month. Æ

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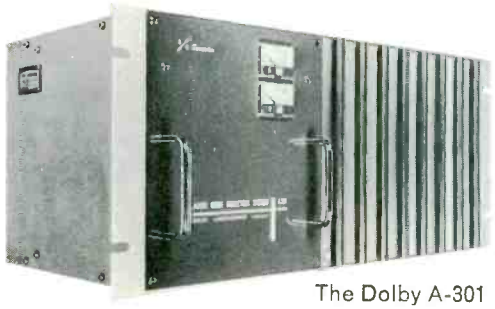

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Crossover Distortion in Transistor Power Amplifiers

JAMES BONGIORNO*

The author examines the cause and effect of crossover or "notch" distortion in a power amplifier's output stage

CROSSOVER DISTORTION in transistorized amplifiers has been recognized for more than a decade now. In the early days of solid-state amplifiers it manifested itself as brittle, irritating music reproduction.

In addition, laboratory measurements revealed *higher* distortion at low listening levels when compared with high listening levels. This was contrary to experience with vacuum-tubed amplifiers, where it was axiomatic that the lower the power used, the lower the distortion. This type of distortion appears as a non-linear transfer of a signal when it is near the zero axis. One of the difficulties that faced power amplifier designers a few years back was due to transistor devices that were extremely non-linear at low collector currents. This non-linearity could be termed V_{be} and beta dropout. For example, in a single-diffused device such as a 2N3055, my spec sheet (see Fig. 1B) stops the beta curve at 80 mA. Much better devices are available today. And there's one type, not much used in consumer products, that seems to be attracting the attention of design engineers — the triple-diffused planar power transistor. This one wins the most-linear-device contest hands down, but the present cost is quite high. Even as it stands now, however, early problems assocated with low-level distortion in transistor amplifiers have been largely solved, with only an exception here and there.

*Consulting Engineer

Crossover "notch" distortion, on the other hand, has nothing to do with output power level, as often assumed. "Primary crossover" distortion (see Fig. 2.) is due to using Class-B operation, where signal current is not flowing during a portion of each half cycle in the power output stage. In effect, there's a time lag between the period when one transistor is "on" and another in a push-pull circuit is "off." This can be corrected by increasing bias current so that the "on" transistor time is longer than the "off" transistor time, thereby minimizing any discontinuity in signal.

What many people fail to realize, however, is that there is another type of crossover distortion — secondary crossover distortion! And this one *still* plagues solid-state power amplifiers.

Whereas primary crossover distortion is the result of a loss of signal during a time period, secondary crossover distortion or notch distortion has nothing to do with the absence of signal. Rather, it is the result of inherent transistor switching deficiencies that cause switching transients to occur. Let us first examine the nature of this secondary distortion, and then examine a few modern output circuits to learn how some manufacturers have taken different approaches to alleviate the problem. (Some efforts to reduce it have been fairly successful, but none has been *fully* successful.)

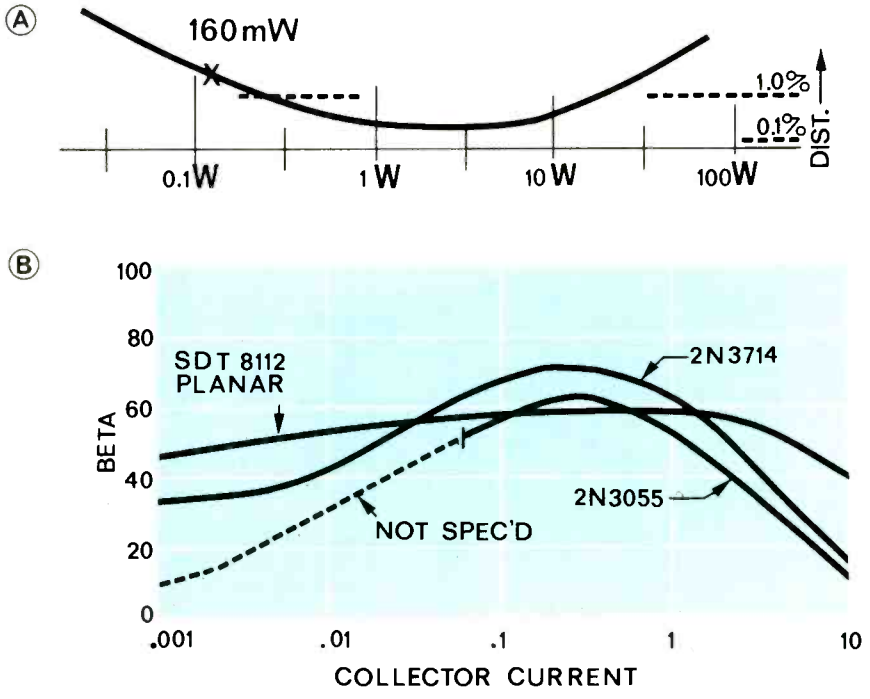
"Notch" Distortion

If a close examination is made of Lissajous distortion patterns produced by a solid-state power amplifier, one will observe that there are only two spikes in the waveform when "primary" crossover distortion exists. In contrast, secondary crossover distortion or "notch" distortion usually exhibits four spikes in the waveform, two of which are generally subdued ones. And whereas the spikes in primary crossover distortion are in the center of the waveform display, the notches of secondary crossover distortion are decidedly away from the 'scope display's center.

The drawing in Fig. 3A shows a normal complementary emitter-follower output, drawn this way for simplicity. Figure 3B reveals what the circuit *really* consists of because of the inherent capacitance inside the transistors. Since crossover distortion is a *frequency*-selective phenomenon, becoming greater as frequency is increased, it must be caused by some reactive action. Also note that, in Fig. 3C, resistors have been added in the emitter circuits to stabilize the bias. If there is any inductance at all in these resistors, it will make the crossover notches *worse*.

Crossover distortion occurs here because capacitors C_1 through C_4 charge up and discharge during alternate half

Fig. 1—Typical low-level transfer distortion is shown in (A), while (B) illustrates the beta dropout at low current of some transistor devices. The poorest of the lot, 2N3055 output types, has been widely used by many manufacturers.



cycles of the signal. As the frequency is increased, they are charged up more and more because of the nature of the capacitive effect. When the drive signal alternates on half cycles, these capacitors do not discharge immediately because they are already charged in the *reverse direction*. Upon the drive signal changing polarity, the transistor cannot turn on immediately because the reverse charge holds it off for an instant. The same thing happens on turn-off, but the effect is less noticeable because the maximum charge on C_2 or C_3 is limited to the BV_{on} emitter-base junctions of the output transistors. But C_1 and C_4 can charge to the full value of the power supply because one end is grounded through the supply. Also, the inherent charge-storage time of the transistors adds to the dilemma being the real culprit in producing the huge turn-off notch.

It is almost impossible to remove these switching transients from a Class B output stage. Also the problem can-

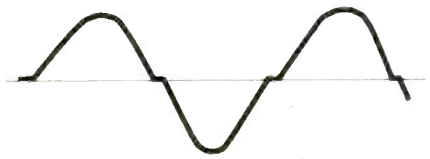


Fig. 2—Primary crossover distortion.

not be solved by using high-frequency power transistors as they still have inherent capacitances and storage times, and as stated earlier, crossover distortion is not a function of bandwidth.

According to the previous statements, a discrepancy might exist in the fact that the transistor is supposed to be a perfect switch (excluding power FETS that are at the present time incredibly high priced). Any engineer knows that every transistor, even the fastest, has finite delay and storage times which bears out the capacitive effect. So, therefore, transistors are *not* perfect switches.

Turning to Fig. 4, we see the waveform of the upper transistor of Fig. 3. This waveform is a current waveform (not voltage) and is represented by the heavy line. The lower transistor is represented by the dotted line. A close-up examination of the circled portions is shown in Fig. 5, in which (B) represents turn-on and (A) represents turn-off. One will immediately notice that the turn-off spike is much larger than the turn-on spike, bearing out some of the previous statements. These drawings are of the output stage biased past the zero-axis, which would represent Class AB, or at low levels, Class A. Fig.

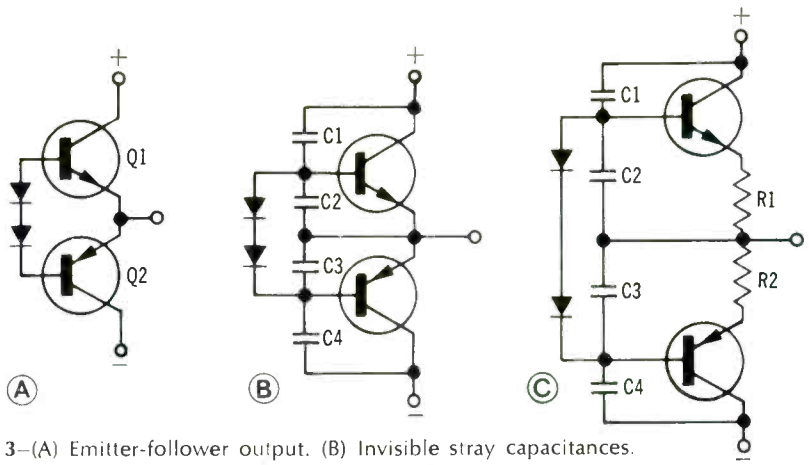


Fig. 3—(A) Emitter-follower output. (B) Invisible stray capacitances. (C) With bias-stabilizing resistors.

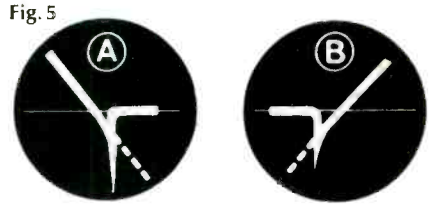
ure 6 shows what happens when the bias is increased further. In all cases the drawings are greatly exaggerated to show the effect. Obviously, if the bias is increased enough we will eventually reach pure Class A operation. This would be greatly inefficient, however, but I don't doubt that somone has done this in the belief that it is the only solution to the problem.

It would be interesting to examine some of the commercially available products in order to see what is being done to solve the problems. The first, and by far the most popular—for economical reasons—is the old Lin circuit, or by its more familiar name, the *Quasi*-complementary output. This is shown at (A) in Fig. 7 with the inherent capacitances shown dotted. The

Fig 4—Current waveform of Q_1 in Fig. 3. Note turn-off (A) and turn-on (B) notches greatly exaggerated.

Fig. 5—Magnified (A) Turn-off notch and (B) Turn-on notch.

Fig. 6—The effect of increasing the bias (greatly exaggerated).



crossover distortion produced by this type of output stage is shown at (B). The large notches are caused by turn-off and the small ones by turn-on. If the bias is further increased, the large notches will diminish and move further towards the outside of the display, while the small notches will disappear. As the bias is reduced, the large notches increase and move towards the center of the display and will eventually turn into primary crossover distortion. This action may not be evident in all cases since the amount of power delivered through the base-emitter junction may vary greatly depending on the size of the transistor chip itself. In other words, in low-power output stages where only a single emitter-follower output is used, there may be no or little secondary crossover distortion even as the bias is increased. I have noticed this effect as the primary crossover distortion disappeared when the bias was increased, but there was not much ensuing secondary crossover distortion. I attributed this only to the limited number of large junctions in the output stage.

If one examines the Lissajous pattern, the second-harmonic content is obvious in the figure-8 pattern. But the notches can range anywhere from five to ten times or more the height of the second harmonic. At 20 kHz the second harmonic is 40 kHz, and the spikes may reach out to 400 kHz in harmonic content and possibly further than that. Many people will say that nobody can hear out to these high frequencies so why worry about it. Tests show that they are evident in listening. [*An unusual experiment by the author will be described next month to prove this claim—Ed.*]

There is also a further problem in measurement. Unless the analyzer used is capable of wideband measurements, at least out to a megahertz or so, the

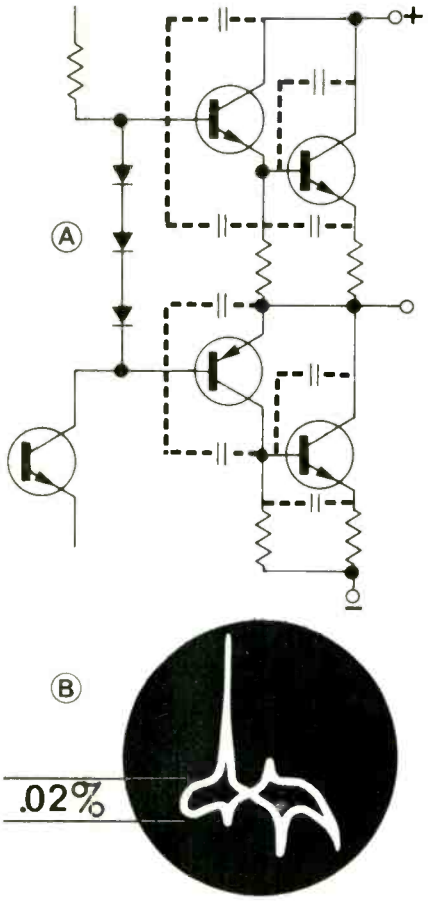


Fig. 7 – (A) Quasi-complementary output stage showing strays. (B) Typical distortion waveform produced by this stage.

notches will be quite subdued, if present at all. Low-cost kits will almost never be capable of the required bandwidth, and therefore are not suitable. All measurements for this article were made with a Hewlett-Packard 331A distortion analyzer with special filters which has useful response out to about 4 megahertz, and a 50-megahertz Fairchild 767H scope. The oscillator used was a special design which has a residual distortion of around .002 per cent.

Getting back to Fig. 7B, one might notice a difference in the notch heights between the large top one and the smaller bottom one. This is due to the different transfer characteristics of the two output-stage halves. The worst one by far is the top half which contains the double emitter follower. This occurs because there are two junctions to switch off, while there is only one junction on the bottom half. Many engineers must have noticed this difference and have gone to using completely complementary outputs to solve some of these problems. It would be interesting to look at a couple of these circuits, which have both been published before, although not necessarily explained.

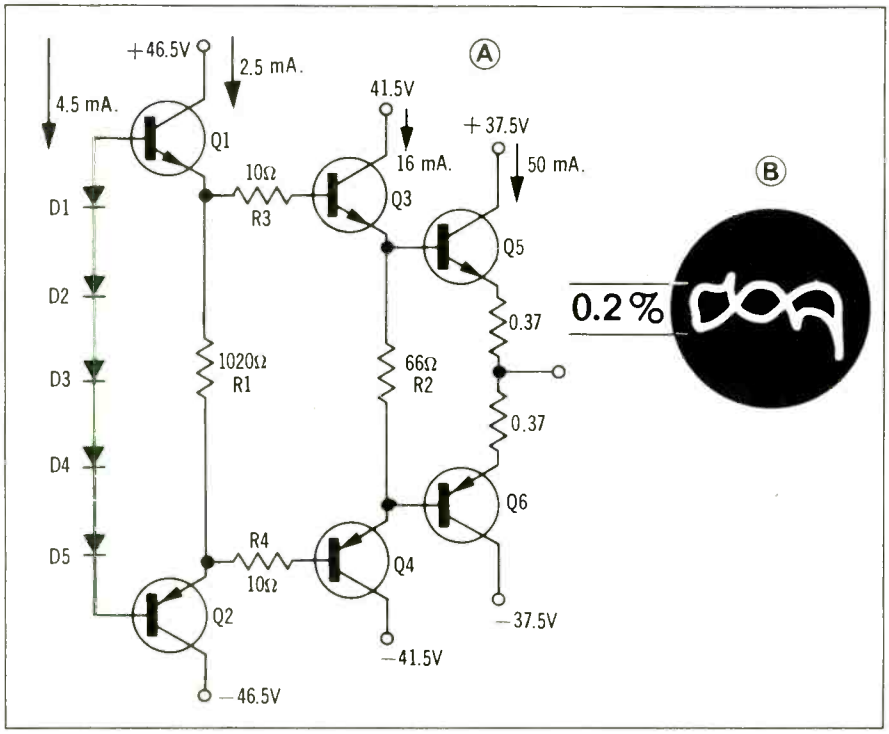
Commercial Output Stages

The first one is the JBL T-Circuit as shown in Fig. 8. The output stage consists of three cascaded complementary emitter followers. The circuit is unique in several respects. What is most unusual about the circuit is that the four driver transistors, Q_1 through Q_4, never cutoff at any time. They are always conducting on both half cycles. Because of R_1 and R_2, current will always flow in the same direction. Only the output devices themselves, Q_5 *and* Q_6, will cutoff on alternate half cycles. But since the drivers never cutoff there will be very little charging of the capacitances and hence little crossover distortion. But there will be some, even though it is small, and some very small notches at the low frequency of 200 Hz were noticed. JBL engineers have used a very cute trick by introducing R_3 and R_4, which apart from helping to stabilize the bias under high temperature conditions, also help to neutralize the reverse current flow when driving an elliptical load line.

Before the first of several of these amplifiers was measured, it was assumed that there would be third-harmonic distortion by its very nature, simply from viewing the schematic, rather than second harmonic. It was a surprise to find that the distortion products were almost *all* 3rd harmonic, and at nearly all frequencies. This assumption was made because there was a triple transfer function in the output stage rather than a double or single transfer function. It was extremely difficult to view the crossover notches while measuring the JBL, only because they were below the harmonic content. How many engineers have assumed that since the notches are masked by the harmonic products, they don't exist?

Another product, using a totally different design approach, is the Marantz Fifteen which is diagrammed in Fig. 9. In the Marantz design, diodes D_1 and D_2 play an important role in the reduction of crossover distortion. The approach can be understood better if we view the transfer characteristics as shown at (A) and (B) in Fig. 10. Figure 10A shows the transfer characteristic without diodes D_1 and D_2. The switching characteristics are very sharp and abrupt, and the distortion waveform is shown at (B). Figure 10C shows what happens to the transfer function when diodes D_1 and D_2 are added, making the necessary bias adjustments. Due to the tremendous capacitances of the power diodes in the *forward* direction at high frequencies, the transfer function becomes very smooth, much like a triode rather than a pentode. The crossover notches are much lower than the inherent harmonic distortion. This

Fig. 8–(A) Equivalent of the JBL amplifier circuit. (B) Typical distortion produced (note very small notches).



IF THE CROWN CX822 IS JUST ANOTHER TAPE RECORDER

– the Stradivarius is just another violin

The Crown CX822 has been opening eyes in testing labs all over America. In early 1968, Audio magazine put it to the test, and published its findings in the April Equipment Report. Following are a few excerpts from that report:

"The Crown CX822 . . . is probably the finest tape recorder that has been reviewed in these pages. In addition to delivering phenomenal performance, it incorporates numerous features and refinements that place this machine in a class by itself."

"Tape threading is delightfully simple."
"Editing facilities are great."

"We found the tape motion command system to be as foolproof as Crown says it is, and could not beat the computer by design or by accident."

"The CX822 is a serviceman's dream, considering the unit's inherent complexity."

"Playing back first-generation transfers from original masters, the sound produced through the Crown CX822 was peerless. When recording and playing back from records and FM broadcasts, there was absolutely no aural difference between the original and the copy at 15 ips. The same held true at 7½ ips, though theory says, there should have been."

"Construction appears to be rugged enough to withstand parachute drops."

"The new Crown CX822 is capable of providing the most faithful reproduction of sound through the magnetic recording medium that we have observed to date. And it does it in as foolproof and as easy a way as we've seen."

Crown

The Stradivarius of the Tape Industry

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Elkhart, Indiana 46514

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smooth symmetry is also achieved because *all* the output current and *all* the output voltage is referenced back to the input *inside* the bias loop. Notice that I said bias loop and not feedback loop.

There is also a further difference in the Marantz amplifier which is unlike all other units encountered. The output stage is current driven rather than voltage driven as in the JBL and Lin circuits. This is beneficial in the sense that a current drive must be symmetrical at high currents, where a voltage drive becomes very nonlinear. This is offset in the JBL circuit by using a triple emitter follower which greatly increases the power gain. However, driving an output stage is not the subject of this article. But it should be assumed that *all* the distortion should come from the output stage of an amplifier, although this may not be true in all cases.

Next month, modified versions of the above amplifiers, plus others, are employed in a listening experiment. *Æ*

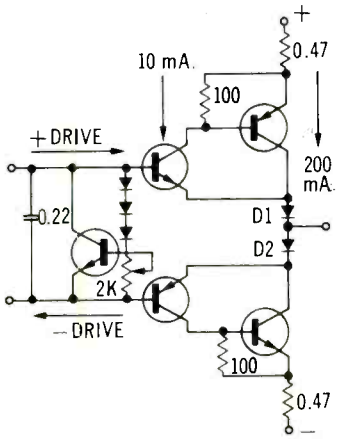
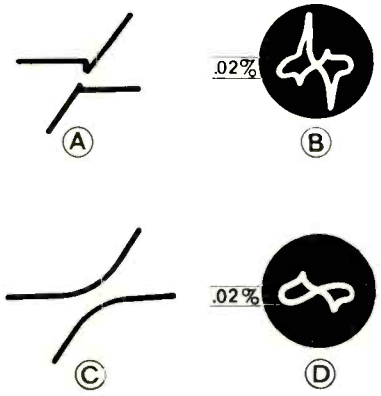


Fig. 9—Equivalent of the output stage of the Marantz Fifteen amplifier.

Fig. 10—(A) Transfer function, and (B) distortion pattern of the amplifier of Fig. 9 without diodes D_1 and D_2, and the transfer function (C), and distortion pattern (D) of the amplifier of Fig. 9 **with** diodes D_1 and D_2.



ABZs of FM

LEONARD FELDMAN

"Front-end" Alignment

ALIGNMENT OF THE r.f. sections of an FM tuner or receiver is surprisingly similar to the methods used for AM radio alignment. Most r.f. tuned circuits are single-tuned (or single peaked) which requires that they simply be tuned for maximum output. This makes r.f. adjustment actually simpler in many respects than i.f. adjustment. R.f. alignment should never be attempted unless the i.f. system is known to be in perfect alignment. In addition, if an AFC circuit is present in the tuner or receiver, it should be defeated or deactivated before r.f. alignment is undertaken.

In most cases, alignment of the r.f. section will include making certain that the receiver, after alignment, meets its published specifications, particularly with regard to "quieting sensitivity," or IHF "least usable sensitivity." For this reason, it new becomes imperative that the exact number of microvolts reaching the antenna terminals of the receiver under test be known. With today's ultra-sensitive tuners and receivers, this means that the r.f. generator used must be capable of attenuation down to a fraction of a microvolt. Furthermore, when the generator output is reduced to its minimum, there must be no "leakage" or radiation of r.f. from the transmission cable, the generator metal housing or even the a.c. power cord. These shielding requirements are part of what makes good FM generators so expensive.

Manufacturers involved in the design and production of FM receiving equipment often test their products in a magnetically and electrostatically shielded room, often called a "screen room," since tightly woven copper screening is usually used to cover walls, ceiling, and floor, as well as any doorways leading into the room. The use of such a shielded room prevents broadcast signals from nearby stations from interfering with the alignment and test process. The IHF standard for tuner measurement (and alignment) requires that tests be made at three frequencies: 90 MHz, 98 MHz, and 106 MHz. Since there may well be stations within 100 kHz of all of these frequencies, it is important to block out reception of these stations and deal only with the r.f. produced by the signal generator.

As mentioned previously, the coaxial cable should connect r.f. energy to the antenna terminals by means of a matching network. Most generators have an internal "output impedance" of 50 ohms, while most FM tuners have input impedance of either 75 ohms or, more popularly, 300 ohms. In the case of a balanced 300-ohm system (the most popular type), the network shown in Fig 1 should be used to provide a proper match between generator and receiver or tuner. Since a voltage drop will take place across the series resistors, however, the actual number of microvolts reaching the tuner or receiver antenna terminals will be *half* the number of microvolts read on the calibrated dial of the generator.

Test points for connecting a VTVM or an oscilloscope are the same as those used for i.f. alignment, since the i.f. system, having been previously aligned,

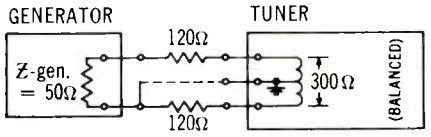


Fig. 1—Matching network required for connecting 50-ohm generator to 300-ohm balanced antenna input on FM tuner. Dotted connection may be omitted with practically no increase in mismatch.

is now being used as a fixed amplifier. If using a meter as the indicator, the steps to be followed are these:

1. Set the tuner dial to 106 MHz and set the FM signal generator to the same frequency.

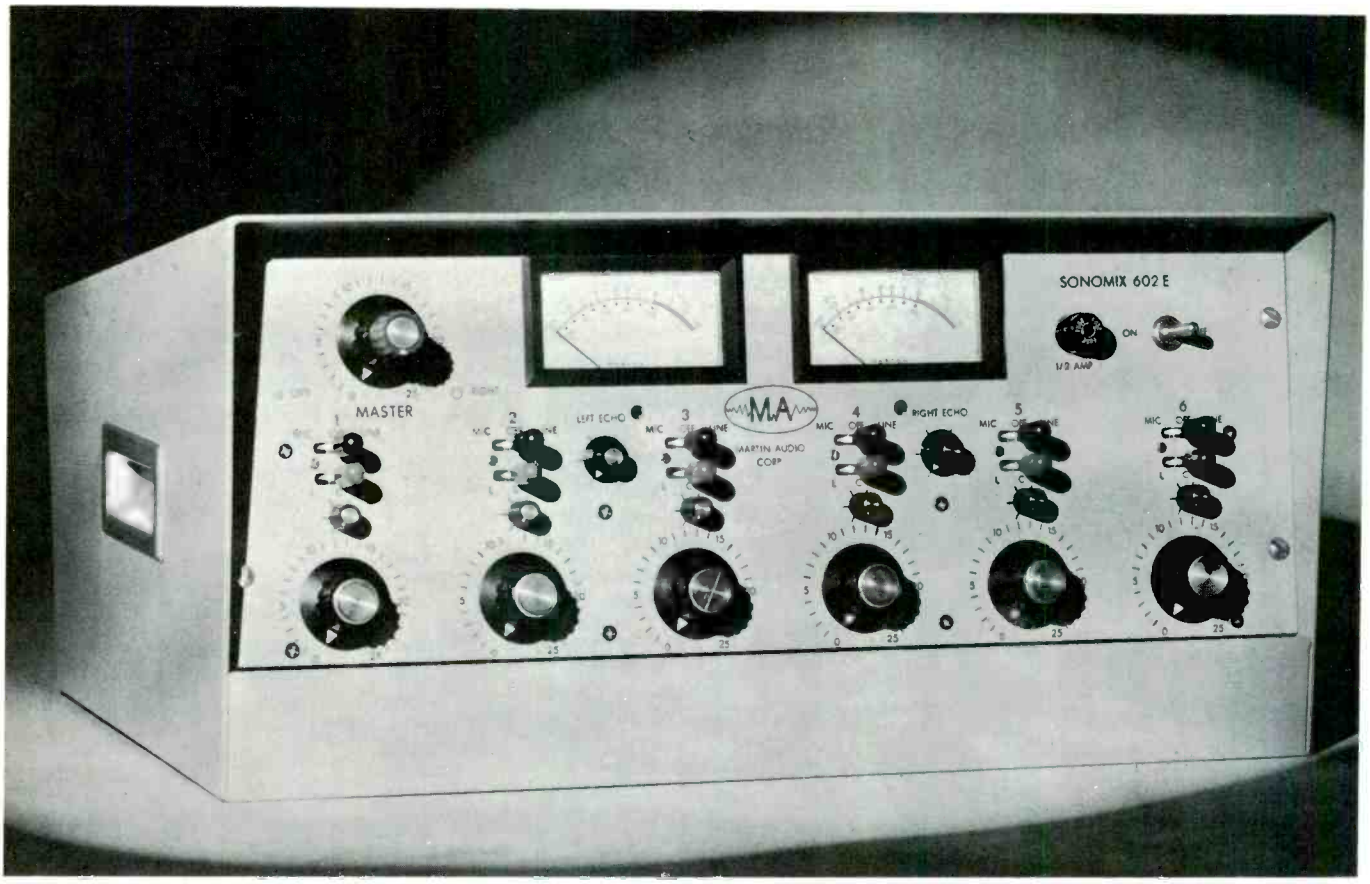
2. Adjust the oscillator section trimmer capacitor for a peak indication, rocking the trimmer adjustment back and forth a couple of times to make sure absolute peak has been achieved. Always work with the *least* amount of r.f. signal consistent with on-scale meter readings, using the lowest available scale of the VTVM.

3. Adjust trimmers of all r.f. sections of the variable capacitors for a peak indication. The number of trimmers will depend upon the number of tuned sections there are in the r.f. section of the set under test.

4. Repeat all adjustments, at a lower signal level, if possible. In many circuits, adjustment of one trimmer may affect adjustment of others, and so the final adjustment points should be "zeroed in" by repeated adjustments—including even the local oscillator trimmer.

(Continued on page 62)

Martin Audio announces the first professional stereo mixer with built in echo mixing facilities



SONOMIX 602E

Sonomix 602 is the newest member of our mixer family. It incorporates all the features of the Sonomix 601 mono — six microphone or line inputs, AC or accessory ni-cad battery pack — plus dual stereo outputs with each mixing pot switchable to left, center or right channel. Each input has its own echo pot, which mixes to a mono echo send to drive an external echo chamber. The echo signal is fed to left and right echo return pots, and mixed with the channel outputs.

- **95DB Gain ▪ 200 Ω Microphone Inputs ▪ 100 kΩ Line Inputs**
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- **XLR Connectors on MIC Inputs and Line Outputs**

Model 602E with echo mixing and desk top cabinet	**$1005**
Model 602E without cabinet for rack mounting	**$ 945**
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AUDIO ENGINEERING SOCIETY

PROGRAM

Thirty-sixth Convention

and Exhibition of Professional Products

April 28-May 1, 1969

HOLLYWOOD ROOSEVELT HOTEL
7000 Hollywood Boulevard, Hollywood, Calif.

REGISTRATION: Mezzanine, 9:30 AM-8:00 PM

EXHIBITS: Monday and Tuesday: 1:00 PM-9:00 PM
Wednesday and Thursday: 1:00 PM-5:00 PM

THE TECHNICAL PAPERS

For readers unable to attend, many of these papers can be had in preprint form (50¢ ea., AES members; 85¢ ea. non-members) from Audio Engineering Society, Inc., Room 248, The Lincoln Building, 60 E. 42nd St, New York N. Y. 10017. Write for list of available titles.

Monday, April 28:

(10:00 a.m.)

AMPLIFIER AND AUDIO CIRCUITS

Chairman: Paul Spranger, Altec Lansing

A1 Design considerations of low-noise audio input circuitry
A. Douglas Smith, Shure Brothers, Inc.

A2 Transmission lines in studios
O. Everett Wiedmann, LTV Research Center

A3 An unusually flexible OP amp mixing console
Lyle Fain, Fedco Audio Labs

A4 Bridging the audio limiter gap
James J. Noble and Robert James Bird, Altec Lansing

A5 Automatic presence equalizer
Richard G. Allen, Emil L. Torick and Benjamin B. Bauer, CBS Laboratories

A6 Low-noise replay-preamplifier for professional audio recorder
Zoltan Vajda, University of Minnesota

(1:30 p.m.)

TRANSDUCERS

Chairman: B. R. Beavers, LTV Research Center

B1 A new user-oriented professional unidirectional microphone
Robert B. Schulein, Shure Brothers, Inc.

B2 A new underwater earphone
Louis A. Abbagnaro and Benjamin B. Bauer, CBS Laboratories

B3 Loudspeaker phase characteristics
Richard C. Heyser, Cal. Tech. Jet Propulsion Laboratory

B4 The meaning of quantitative loudspeaker measurements
Charles McShane, Acoustic Research, Inc.

B5 Loudspeaker voice coils
John King, Cleveland Electronics

B6 Design parameters of a dual woofer speaker system
Edward M. Long, Ampex Corp.

B7 An improved theatre-type loudspeaker system
John K. Hilliard, LTV Research Center

B8 Recent developments in high-frequency drivers and horns for auditorium sound reinforcement
William L. Hayes, Altec Lansing

(8:00 p.m.)

Held at A&M Studios, Sunset Blvd. & La Brea, Hollywood, Calif.

AUDIO SYSTEMS

Chairman: Jack Purcell, Purcell & Noppe & Associates, Inc.

C1 A directional communications receiver for underwater swimmers
Guy V. Love, Emil L. Torick, Benjamin B. Bauer, CBS Laboratories

C2 A recording console for the needs of tomorrow
Robert A. Bushnell & J. Jerrold Ferree, Bushnell Electronics Corp., Van Nuys, California and United Recording Corp.

C3 A comparison of the performance of VU and peak reading meters
Richard D. M. Negus, Capitol Records, Inc.

C4 A description and tour of the new A&M studios
Howard Holzer, HAECO, Larry Levine, A&M Records, and Jerry Christoff, Paul F. Vaneklasen & Associates

Tuesday, April 29:

(9:30 a.m.)

ACOUSTICS AND HEARING

Chairman: Mark B. Gardner, Bell Telephone Laboratories, Inc.

D1 An experimental sound system for the Hollywood Bowl used in 1936
Arthur R. Soffel, LTV Research Center

D2 Talking and listening levels in verbal communication—Importance of specifying parametric values
Mark G. Gardner, Bell Telephone Laboratories, Inc.

D3 Sound reproduction in the home
Harry F. Olson, RCA Laboratories

D4 Acoustics of multipurpose auditoriums
Vern O. Knudsen, University of California at Los Angeles

D5 The ear as an instrument for determining the quality of musical tones
Harvey Fletcher, Brigham Young University

(1:30 p.m.)

MUSIC AND SPEECH

Chairman: James Campbell, University of California

E1 New music buildings—the sonic environment
Gerald Strang, California State College at Long Beach, Department of Music

E2 Loudness meter
R. A. Hackley, H. F. Olson and D. S. McCoy, RCA Laboratories

E3 Some recent developments in computer-generated tone qualities
J. C. Risset, Bell Telephone Laboratories, Inc.

E4 A music department, born: 1 July 1966; Died:
James L. Campbell, Department of Music, University of California

(7:30 p.m.)

NOISE

Chairman: Karl S. Pearsons, Bolt Beranek and Newman, Inc.

F1 Transportation noise source
Richard C. Potter, Wyle Laboratories

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The best your money can buy. Period!

Lightweight. A full 7-inch reel capacity professional studio tape deck. Pick it up and take it anywhere. Operates on a self-enclosed rechargeable nickel-cadmium battery pack—or plugged into AC.

Four Heads. The 770-2 has two-track erase, record, and playback heads plus a four-track playback head. The 770-4 has four-track erase, record, and playback heads plus a two-track playback head.

Better-than-Studio Specs. Frequency response: 20 Hz to 22 KHz, 40 Hz to 18 KHz ±2 dB @ 7½ ips. S-N ratio at peak level to unweighted noise: (Model 770-2) 58 dB or better; (Model 770-4) 56 dB or better. Wow and flutter: less than 0.09% @ 7½, less than 0.12% @ 3¾, less than 0.2% @ 1⅞.

ServoControl Motor with VariSpeed Tuning. Automatically maintains exact speed during mechanical load changes and voltage variations. Built-in VariSpeed tuning permits vernier adjustment of plus or minus 7% of any of the three speeds. Ideal for pitch tuning to any musical instrument.

Exclusive Sony Noise-Reduction System. Sony "SNR" automatically reduces gain of playback amplifier by 6 dB during very low passages, when background noise is most predominant. Noise level is greatly reduced, dynamic range expanded 100%. Also incorporated is a built-in limiter to automatically control overload distortion. Both "SNR" and limiter are switch defeatable.

Three Speeds. 7½, 3¾, 1⅞ ips. Other features include two professionally-calibrated VU meters, built-in line-and-mike mixing, push-button operation, scrape flutter filter, low-impedance Cannon plug mike inputs, tape/source monitoring.

Sony Model 770. Priced at $750. For a free copy of our latest tape recorder catalog, write to Mr. Phillips, Sony/Superscope, Inc., 8142 Vineland Avenue, Sun Valley, California 91352.

SONY SUPERSCOPE

You never heard it so good.

Monday, 7:30 p.m.—Cont'd.

NOISE

F2 Plumbing noise control
Ronald McKay, Bolt Beranek and Newman, Inc.

F3 Updating and interpreting the speech interference level (SIL)
John C. Webster, U.S. Navy Electronics Laboratory

F4 Human phase sensitivity to impulse signals
Sanford Fidell, Bolt Beranek and Newman, Inc.

F5 Procedures for evaluating damage risk from exposure to noise
Karl D. Kryter, Stanford Research Institute

F6 Evaluation of ear protection devices
John E. Parnell, PNP Associates

Wednesday, April 30:

(9:30 a.m.)

DISC RECORDING

Chairman: Frank E. Pontius, Westrex

G1 A tape-to-disc mastering system featuring unique control and monitoring facilities
Jack K. Williams, Pacific Recorders and Engineering

G2 A new and improved solid-state driving system for the Westrex 3D and HAECO SC-1 stereo cutterheads
Howard S. Holzer, HAECO

G3 The first all solid-state stereo recording package for disc recordings
Stephen F. Temmer, Gotham Audio Corp.

G4 Performance characteristics of the commercial stereo disc
John M. Eargle, RCA Record Div.

G5 The dynamic range of disc records
Daniel W. Gravereaux and Benjamin B. Bauer, CBS Laboratories

G6 Automatic record pressing
William S. Bachman, Columbia Records

(1:30 p.m.)

TAPE RECORDING

Chairman: Keith O. Johnson, Gauss Electrophysics, Inc.

H1 A simple tailoring machine for Philips cassettes
James B. Wood, General Recorded Tape, Inc.

H2 Magnetic tape testing and interpretation
Klauss E. Naumann, BASF Computron, Inc.

H3 The measurement of medium-wavelength flux on a magnetic tape record
John G. McKnight, Ampex C & E Products Div.

H4 A simplified-hysteresis-loop model of the AC biased magnetic recording process
Zoltan Vajda, University of Minnesota

H5 An examination of dropouts occurring in the magnetic recording and reproduction process
William Van Keuren, Jet Propulsion Laboratories

H6 Design improvements applied to the Fairbanks time-alteration device for recorded sound and uses of the time-alteration technique
Wayne Graham, Discerned Sound

Thursday, May 1:

(9:30 a.m.)

SIGNAL PROCESSING

Chairman: William G. Dilley, Spectra Sonics

A series of five separate panel discussions, followed by audience/panel participation.

J1 Microphone
1. David Ronne, Metromedia Producers Corp.; 2. Thomas May, Columbia Records; 3. L R. Burroughs, Electro-Voice, Inc.

J2 Equalization/Filtering
1. Lawrence Levine, A&M Records; 2. H. Philip Iehle, Atlantic Records; 3. John P. Jarvis, Universal Audio Division of UREI

J3 Compression/Limiting
1. Richard Welch, Bonneville International; 2. DeWitt F. Morris, United Recording Division of UREI; 3. Charles F. Swisher, Christopher Jaffe & Associates, Inc.

J4 Reverberation/Echo
1. John Neal, Western Records Division of UREI; 2. Richard Stumpf, Universal Studios; 3. Stephen F. Temmer, Gotham Audio Corp.

J5 Tape machine
1. Thomas Hidley, T. T. G., Inc.; 2. Hamilton Brosious, Scully Recording Instruments Corp.; 3. C. Dale Manquen, 3M Company; 4. Leon A. Wortman, Ampex Corp.

(1:30 p.m.)

INSTRUMENTATION

Chairman: Bernard Katz, B&K Instruments, Inc.

K1 Reliability in production testing of loudspeaker components and systems
Donald S. Schroeder and Edward M. Long, Ampex Corporation, Elk Grove Village, Illinois

K2 Automated frequency-response measurement
Allen E. Byers, United Recording Electronics Industries

K3 Crosstalk meaurements on magnetic recording heads
Robert E. Barbour, Nortronics Co., Inc.

K4 Real-time spectrum analysis
David Rose, Hewlett-Packard

K5 Real-time spectrum analysis as a tool in Acousta-Voicing
Don Davis, Altec Lansing

K6 The seven deadly sins of instrumentation
E. John Wootten, B&K Instruments, Inc.

K7 Instrumentation techniques used for performance evaluation of hearing aids
Erwin Weiss, Beltone Electronics Corp.

K8 On the objective testing of circumaural hearing protectors
R. H. Campbell, David Clark Company, Inc.

SESSION L

(7:30 p.m.)

SOUND REINFORCEMENT

Chairman: Charles F. Swisher, Christopher Jaffe & Associates, Inc.

L1 A sound reinforcement system for multiple conference rooms
Melvin S. Draper, The Boeing Company-Space Div.

L2 Location of loudspeakers in sound reinforcement systems
Don Davis, Altec Lansing

L3 A new music and sound-effects system for theatrical productions
Dan Dugan, American Conservatory Theatre

L4 Comparison of room-loudspeaker response in well-behaved reverberant rooms to the response in an anechoic environment
James Long and William Raventos, Electro-Voice, Inc.

L5 Design innovations in a modern portable sound reinforcement system
Stephen W. Desper, Beach Boy Entertainment Enterprises, and Robert L. Bennett, Quad-Eight Sound Corporation

L6 Sound amplification system for the San Diego All American stadium
Wilfred A. Malmlund and David L. Klepper, Bolt Beranek and Newman, Inc.

OUR NEWEST STEREO TUNER

The stereo FM-3 was introduced in 1963 and we are still barely able to keep up with the demand. After six years, it remains the most popular of all stereo tuners.

Our newest stereo tuner doesn't replace the original mono FM-1, which after nine years still outsells all other mono tuners combined.

This unprecedented longevity is explained by Dynaco's unswerving devotion to performance, reliability and unmatched low cost. The stereo FM-3 is only $99.95 as a kit and $154.95 factory assembled. The $79.95 mono FM-1 can be converted to stereo at any time by adding the $29.95 FMX-3 multiplex module.

Dynaco introduces new products only when they fill a real need. They never render previous models obsolete. And at less than half the cost of other tuners, such consummate value just naturally gets around.

We can't promise that the FM-3 will still be our newest tuner in 1979.

But we do know it won't be out of date.

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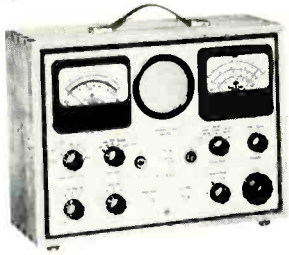
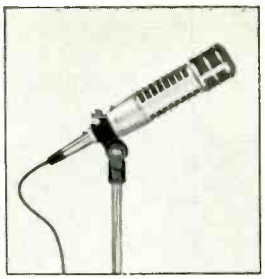
The Product Sampler

The following sampling of the new and interesting equipment to be shown at the 36th AES Convention and Exhibit illustrates some of the professional gear that serves to keep up the high standards of the audio profession.

Altec 9477A
100-W Amplifier



B & K Type 2006
Heterodyne Voltmeter



Electro-Voice
RE-20 Microphone

Abphot Corp. will introduce its new Model 1302 Audio Analyzer, intended for general-purpose audio measurements where a balanced signal source is not required. The frequency range has been extended from 120 Hz to 1.2 MHz for the generator, and from 1 to 3 MHz for the voltmeter. Also built-in is a tracking distortion meter with a sensitivity of 100 mV set level and 0.3% THD full-scale reading, and a direct-reading phase-angle measurement between send and receive signals. High-pass and low-pass filters are also included, and the meter sensitivity extends down to −80 dBm. The unit is flat within ±0.2 dB over the entire operating range.

Check No. 21 on Reader Service Card

AKG Div., North American Philips Corp. will show two new microphones —the D-190E cardioid dynamic with a user net of $50.00, and the D-900E dynamic "shotgun" model with a user net of $149.00. The latter is 26⅛" long and exhibits a 20-dB rejection at the sides and back throughout the entire frequency range. It is equipped with a two-position bass rolloff switch providing cuts of 7 and 20 dB respectively at 30 Hz. The D-190E offers a typical cardioid pattern, with rejection at the rear of 18 dB at 1000 Hz, and the cardioid characteristic is maintained over the entire frequency range.

Check No. 22 on Reader Service Card

Altec Lansing will unveil a number of new products for the broadcast and recording industries, including the Model 9300 broadcast console of modular plug-in design capable of up to 28 input and 24 output channels. Input modules will include preamps, with echo and cue facilities, and a new type of volume indicating device employing light instead of VU meters is introduced. In addition, the famous 9200A and 250T-3 consoles will be on display, together with a new 100-watt solid-state amplifier, Model 9477A. The Model 9473A solid-state limiter amplifier, designed around the concept of spectral separation, which eliminates envelope distortion caused by too short a release time will also be shown, as will the new Senior Monitor/Playback Speakers System, Model 9845.

Check No. 24 on Reader Service Card

Audio Designs & Mfg. Inc. will show their Audex switching modules in three versions — Audex I, which will separately switch a program source to 16 program busses and 4 echo busses, preventing selection of more than one buss at a time, and cancelling the previously selected buss when a new one is selected on the switcher control. Audex II will cumulatively switch a source to any one or all 16 program busses and 4 echo busses, and Audex II, which solves the problem of matrixing in multichannel consoles, since it will accept 20 input sources and combine them to a single output. Channel indication is shown by computer-type digital readout on the face of each module, all of which switch noiselessly with a switching life in excess of 10 million operations.

Check No. 26 on Reader Service Card

AES Exhibitors

Manufacturer	Booth No.
Abphot Corp.	18
AKG—Div. of North American Philips Corp.	1
Altec Lansing	9/10/11
Ampex Corp.	Room C
Audio Designs & Manufacturing, Inc.	45
Automated Processes, Inc.	Mezzanine
B & K Instruments, Inc.	12/13
Creatronics, Inc.	Mezzanine
Dolby Laboratories, Inc.	Rooms H & I
Electrodyne Corp.	17
Electro-Sound	Mezzanine
Electro-Voice, Inc.	Boulevard Room
Fairchild Recording Equipment Corp.	2
Gately Electronics	43
Gauss Electrophysics, Inc.	7/8
Gotham Audio Corp.	21/22
Harman-Kardon, Inc.	Room F
Harvey Radio Co., Inc.	38
Hewlett-Packard Co.	39/40
Holzer Audio Engineering Corp.	25
JBL—James B. Lansing Sound, Inc.	33/34
Langevin, Div. of Scientific Industries, Inc.	5
Lipps, Inc.	16
3M Company	35/36/37
Magnetic Recorders, Co.	24
Martin Audio Corp.	41
McMartin Industries, Inc.	32
Melcor Electronics Corp.	29/30
Metrotech, Inc.	15
R. A. Moog, Inc.	Room E
Nagra Magnetic Recorders, Inc.	47
Nortronics Company, Inc.	44
Parasound, Inc.	
Orban Associatates	Suite 1106/07
Quad-Eight Sound Corp.	14
Scully Recording Instruments Co.	26/27/28
Sennheiser Electronics Corp. (N.Y.)	3
Shure Brothers, Inc.	4
Spectra Sonics	23
Stanton Magnetics, Inc.	45
Superscope, Inc.	31
Taber Manufacturing and Engineering Co.	6
Tandberg of America, Inc.	42
United Recording Electronic Industries:	
Universal Audio	20
Waveforms	20A
Wiegand Audio Laboratories	19

B & K Instruments, Inc. will display a new Spectrum Shaper, Model 124, especially designed for the audio market, along with its Model 123 which has been shown heretofore. And in addition to a wide range of sound level meters, including an impulse type, they will show the Model 2006 Heterodyne Voltmeter, which is ideal for measurements in the r.f. and v.h.f. ranges. It is portable, light in weight, and battery operated to provide maximum flexibility in use. It will measure the amplitude of high-frequency signals and determine their frequency as well as the percentage modulation. The voltmeter covers the range from 40 kHz to 230 MHz, and has a sensitivity ranging from 2 μV to 50 V, with bandwidths of 2.5 kHz and 200 kHz.

Check No. 28 on Reader Service Card

Dolby Laboratories, Inc. will show the KLH recorder as well as Dolby A301 Noise Reduction units and remote change-over unit (enables 301 to change to record or playback configuration remotely). New items are custom-made, heavy-duty portable cases for Dolby equipment. One case is made for a single Dolby A301 unit; a second model case is made for the A301, plus a remote change-over unit. There will be continuous demonstrations of the Dolby system.

Check No. 30 on Reader Service Card

Electro-Voice, Inc. will present the RE20 microphone, a rugged, extremely

This little speaker may cause the downfall of the capitalist system.

Until a few months ago, only capitalists owned high-fidelity systems of really superior quality. For the ordinary rich American, the price was simply too high.

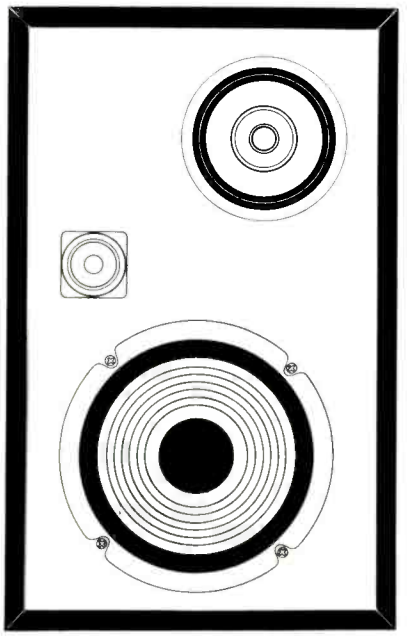
Of course, we aren't talking about those nice middle-class systems for six or seven hundred dollars, with their loud and clear but unmistakably canned sound. We mean the real goods, the big, professional-type stereo installations in which the two loudspeakers alone may have cost well over a thousand.

That kind of capitalist system was economically justified by its performance, until the September Revolution. Then, at the New York hi-fi show last September, Rectilinear introduced a small loudspeaker, called the **Mini-III** and priced at $79.50. After hearing it, even capitalists began to wonder why anyone should pay more for any speaker.

The Rectilinear **Mini-III** is the brainchild of a group of young, unorthodox, we might even say radical, engineers. The kind you'd be more likely to find working for, say, NASA than for the hi-fi Establishment. They took great delight in demolishing the Establishment myth that speaker performance depends on size and price. And they came up with enough bright new ideas to make the 12" by 19" by 19½" deep, under-eighty-dollar **Mini-III** one of the four or five best-sounding loudspeakers available today—regardless of size or price.

If that claim strikes you as so much propaganda, we're not the least bit worried. The superiority of the **Mini-III** isn't so subtle or elusive that you can possibly fail to recognize it when you hear it. Its exceptional smoothness, definition, freedom from distortion and lack of "boxiness" are easily audible characteristics to music lovers.

However, you may not recognize the full consequences of this revolution. The downfall of the capitalist system is just one of them. (Obviously, the same system with the same—or better—sound for about a thousand dollars less is no longer exclusively for capitalists.) But middle-class and even lower-middle-class systems are also affected.



Suppose, for example, that you've been thinking of buying one of the widely advertised stereo compacts. The better ones cost upwards of $400, complete with their own speakers. Now consider the alternative:

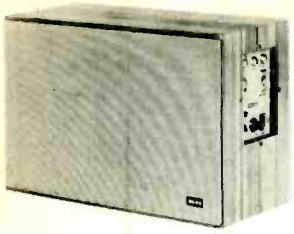
A pair of **Mini-III**'s for $159. One of the new generation of high-powered solid-state stereo receivers (they're great!) for well under $300. One of the best imported four-speed automatic turntables with a good magnetic stereo cartridge, for about $100. Total: just over $500.

This combination will perform almost in a class with the world's most expensive systems and about seventeen classes above the best stereo compacts —for barely $100 more. Plus about ten minutes more of your time, to connect the speakers and plug in the turntable.

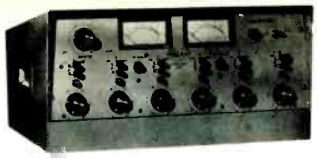
Remember, it's capital that we made superfluous. Not labor.

(For further information, see your audio dealer or write directly to the Rectilinear Research Corporation, 30 Main St., Brooklyn, N.Y. 11201.)

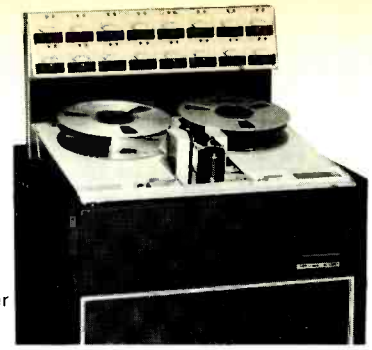
MINI-III
by Rectilinear



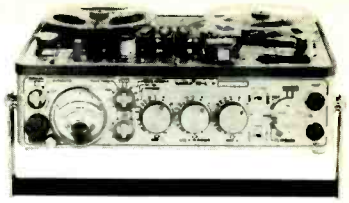
Gotham Model OY Speaker System



Martin Sonomix 602E



3M 16-track, two-inch recorder



Nagra IV Portable recorder

wide-range, high-quality cardioid dynamic model. Its ruggedness is assured by its case which is machined out of solid-steel bar stock, and the cartridge is shock mounted and electrically shielded. A built-in pop filter eliminates any breath or wind noises, and an external mount including extra shock protection is available for boom or stand use. Also to be shown are the RE16 dynamic cardioid microphone created for the most exacting professional use. Physically it is much like the RE15 except for a newly designed blast filter. In addition, its characteristics are carefully controlled so as to match performance closely between two separate microphones of the same model. The RE11 is a similar microphone, but meets requirements where there is less need for precise unit-to-unit matching. All of these models employ the Acoustalloy® non-metallic diaphragm which is exclusive with Electro-Voice. Two monitor speaker systems, Sentry I and Sentry II, will also be a feature of the E-V exhibit.

Check No. 32 on Reader Service Card

Gately Electronics will show their entire line of mixers—in both attache case and console models — together with their new EM-7 Stereo Echo Mixer and accessory four-channel equalizer, EQ-7. The EM-7 mixer handles up to eight inputs (four line and four mike inputs) switch selectable from the front panel, and any mixing or echo-mixing channel can be switch-assigned to either output channel or to both simultaneously. These mixers are stackable to permit increasing the number of input channels to 16, 24, or more, if required. The EQ-7 accessory 4-channel equalizer plugs directly into the EM-7 mixer, and allows adding up to 15 dB of boost or cut at 20 Hz and 20 kHz on four channels independently and simultaneously. Suitable amplifiers are included in the EQ-7 to make up equalization losses.

Check No. 34 on Reader Service Card

Gotham Audio Corporation will show the new Monitor Speaker Model OY, a wall-mounted loudspeaker system containing four speakers and two 30-watt amplifiers. The response of the system is said to be from 40 Hz to 16 kHz ±2 dB. Also to be shown is the ME-102B wow and flutter meter, which is suitable for laboratory investigations and the testing of high-quality recorders. This solid-state instrument includes its own oscillator, and measures between ±.01 and ±1.0%. In addition, they will show the Beyer DT-48S Headphones which have a frequency response which extends to well below 20 Hz and subjectively to beyond 18 kHz, with distortion below 0.3%, making them especially suitable for high-level listening. The Newmann FET-80 Series of transistor condenser microphones will be shown. This series permits serving up to 40 mikes through existing outlets without the necessity of changing the wiring. This series is represented by seven different models of microphones with varying characteristics.

Check No. 36 on Reader Service Card

JBL marks its introduction to the professional monitor speaker field with the initial models, which include the Model 4310—a compact monitor speaker system with independent adjustment of presence (1500 to 7000 Hz) and brilliance (5000 to 15,000 Hz), and capable of handling 35 watts of continuous program power with a smooth frequency responsible from 40 to 15,000 Hz. Dispersion is greater than 90 deg. in both planes, allowing either vertical or horizontal mounting.

Check No. 44 on Reader Service Card

Langevin, a Div. of Scientific Industries, will exhibit a completed program of prewired modules and console housings for nineteen positions. These are available in any one to four output channels. Exclusive features are the new high-level modules that allow 8 to 1 and/or 4 to 1 mix-down, and also provide multi-track wiring to headphones for selected sync work. Also to be shown is the first of a line of high-powered monitor and sound reinforcing solid-state amplifiers, the AM100, which has multiple impedances and low distortion output, with a variety of input impedances. Overload and shorted-output protection is integrated into the overall design.

Check No. 46 on Reader Service Card

Lipps, Inc. plan to display their latest version of a 16-track 2-inch head assembly for multiple-channel recording. This assembly is completely prealigned and contains all necessary hardware, including scrape-flutter idlers and a precision slide control for operating tape-lifter arms. The record head is of Lipps "LXT" design which provides up to 17 dB crosstalk rejection and has a flat response past 10,000 Hz when used for sel-sync playback.

Check No. 48 on Reader Service Card

3M Company will show a compact 2-inch 16-track professional recorder/reproducer featuring an integrated overdub control for remote synchronization of tracks. This model is the latest addition to the line of 3M mastering recorders, which are available in configurations ranging from 150-mil to 2-inch tape widths and two to sixteen tracks. Also to be shown is a model which is convertible to either 1-inch, eight-track, or 2-inch, sixteen track configurations.

Check No. 80 on Reader Service Card

Martin Audio will show the Stereo Sonomix 602 which offers echo mixing facilities and the ability to switch any of its six inputs instantly between line and microphone. It is available with a plug-in rechargeable nickel-cadmium battery pack which permits its use in settings where a.c. power is inaccessible. The unit exceeds studio requirements, yet is packaged in a compact 20 x 8 x 10 in. housing which makes it ideal for travel and location use, or for studios where space is limited.

Check No. 50 on Reader Service Card

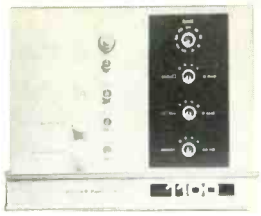
Melcor Electronics Corp. will display a new 100-watt monitor amplifier featuring automatic dissipation-limiting circuitry, high-reliability push-pull-parallel output, and optional isolated 70-volt line output transformer. This model is available in either rack or shelf mounting. In addition, a new Channel Programming Switch module with a built-in pan-pot control will be shown, as well as additional IMPAC modules and power supplies.

Check No. 82 on Reader Service Card

Metrotech, Inc., which recently became a division of Dictaphone Corporation, continues to offer the unique advantage of two-directional record

Shure Model SE20 Phono Preamp


Superscope's Sony C-77 Tele-microphone


UREI Model 1100 Power Amplifier


Wiegand 8-track Mixing Console

and reproduce capabilities, together with front-panel controls for each reel-drive motor. These machines are available in any adjacent pair of standard speeds from 1⅞ to 15 ips, with logger models extending the slow speeds to 5/16, 15/32, and 15/16 ips.

Check No. 53 on Reader Service Card

Nagra Magnetic Recorders, Inc. will feature the new Nagra ¼-in. tape synchronous sound recorder and accessories. The Nagra IV embodies 48 new features not previously available, among them a new modular assembly which makes it possible to include within the recorder a number of formerly external accessories. Automatic mixing with a new dual-timer automatic gain control, automatic overload protection, increased S/N, reduced distortion, and increased permissible recording level are among the new features.

Check No. 54 on Reader Service Card

Quad-Eight Electronics will display a new Monitor Module for multi-track consoles which includes a remote-sync control, stereo mix-down, echo, speaker matrix, and headphone cue. Also featured is an eight-frequency active graphic equalizer with 12 dB of boost and attenuation, available in multi-channel models.

Check No. 69 on Reader Service Card

Sennheiser Electronic Corp. will show their MITEC Synchro-System, distributed solely by Gordon Enterprises of North Hollywood, Calif. This device, which is a wireless system, provides the necessary accessories to connect any professional film camera that is equipped for Neo Pilot Tone to the Nagra tape recorder without connecting cables. The wireless microphone/transmitter/receiver makes the cameraman independent from the sound man, and both may move around freely within the range of the wireless microphone. The unit transmits a pilot sync signal and the start mark, in addition to a talkback channel from the cameraman to the sound man, and all these functions operate simultaneously without interference with each other.

Check No. 70 on Reader Service Card

Shure Brothers, Inc., will feature the SM60 omnidirectional dynamic microphone which is a slim, neat-appearing model which is also rugged and versatile. It is designed for professional applications, and is equipped with a built-in wind and pop filter. In addition, they will show their M67 professional microphone mixer specifically designed for studio, remote, or original sound reinforcement use, or as an add-on mixer for expanding existing facilities. Also to be featured is the SE20 two-channel solid-state equalized preamp/line amplifier designed to provide the highest quality disc reproduction for broadcast and recording studio use. Its high-impedance inputs properly match almost all magnetic disc reproducers, and it is provided with individual high- and low-frequency equalization trimmers on each channel.

Check No. 56 on Reader Service Card

Spectra-Sonics will feature its Model 500 program equalizer, a miniature device employing an active feedback element which will provide boosts and cuts of up to 12 dB in 2-dB steps at any of four high frequencies and any of four low frequencies simultaneously. Measuring only 1½" wide, 3½" high, and 2¾" deep, the equalizer has an insertion loss of zero, and can be attached to panel holes by the nuts on the switch controls. Among other products to be displayed are: amplifiers, equalizers and filters, and console support equipment.

Check No. 64 on Reader Service Card

Stanton Magnetics will show their Models 500A, 500AA and 500E broadcast standard series, as well as the Model 681 Calibration Standard. The 500's are equipped with conical styli in either 0.7 or 0.5-mil radii, while the 500E is fitted with an elliptical stylus with radii of 0.4 and 0.9 mils. All models are flat from 20 to 10,000 Hz ±1 dB, and from 10 to 20,000 Hz ±2 dB, and interchangeable styli make it possible to adapt the cartridge for the most exacting applications.

Check No. 71 on Reader Service Card

Superscope, Inc., will feature the Sony Model 770 seven-inch portable stereo tape recorder (see profile on page 40), along with their latest in miniaturization—the C-115 "Electret" FET condenser microphone which weighs less than a quarter of an ounce and can be worn as a tie tack. In one form—the C-116—the microphone is uniquely equipped with a telescoping rod for better accessibility to the sound source, yet when closed measures only 0.515" by 8.66" and weighs 2 oz. The electret microphone has a diaphragm made of a special plastic film which can be "charged" to provide the polarizing potential for the condenser transducer. The C-77 condenser Tele-microphone, new to the line, is said to be the most highly directional and sensitive microphone in the world. It features a cigarette-pack size booster/headset monitoring pack with a 6-, 12-, or 18-dB gain factor.

Check No. 57 on Reader Service Card

United Recording Electronics Industries will exhibit a highly flexible, 20-input, 12-output recording console containing almost all products of UREI's Universal Audio product line, and which was custom-built for a major Los Angeles studio. They will also show two additional versions of Model 1100 LU, a 75-watt studio monitor amplifier—the 1100 LV, which will have the same features as the LU, plus an output transformer, and the 1100 JV, which features an output transformer but which does not have the equalizer section of the 1100 L series. Also to be shown will be a compressor/limiter option for UREI's Model 2100 S Input Module, which will be available either factory installed or for field modification.

Check No. 72 on Reader Service Card

Wiegand Audio Laboratories will be displaying their new model 1408083 Eight-Track Mixing Console, which is really two consoles in one. It is a 14-input, 8-track console, plus an 8-input, three-track remix console. It incorporates such built-in features as self-contained reverb on all eleven output channels, special-effects switching with graphic equalizer, slating, talk-back, cueing, and test-tone facilities, together with four 120-watt solid-state power amplifiers all in a six-foot wide console cabinet. Other products will include the company's new, solid-state, stereo-disc-recording amplifier system.

Check No. 78 on Reader Service Card

Equipment Profiles

This Month:

- Sony/Superscope Model TC-770-2 Portable Stereo Tape Deck
- H. H. Scott Model LR-88 Stereo FM/AM Receiver Kit
- Rabco Model SL-8 Tone Arm
- Fairfax Model FX-100 Speaker System

Sony/Superscope Model TC-770-2 Portable A.C./Battery-Powered Stereo Tape Deck

MANUFACTURER'S SPECIFICATIONS: Model TC-770-2; 2-track stereo/mono (also available as Model TC-770-4, 4-track stereo/mono). Max. reel size: 7 in. Speeds: 7½, 3¾, 1⅞ ips. Heads: Four—erase, record, play 2-track, play 4-track. Inputs: Low-impedance microphones, auxiliary. Outputs: line, stereo headphone. Frequency Response: 7½ ips, 40-18,000 Hz, ±2 dB. Wow and Flutter: .09% at 7½ ips. S/N: 4-track—56 dB without SNR, 62 dB with SNR; 2-track—58 dB without SNR, 64 dB with SNR. Harmonic Distortion: 2% at 0 dB line output. Dimensions: 16⅛" wide x 5 13/16" high x 15 5/16" deep. Weight: 24 lbs., 11 oz. Price $750.00.

Portable, battery-powered tape recorders are a breed in themselves. They have to be light enough to carry comfortably — they must operate on batteries — they must be flexible — and if they are to be used for professional purposes, they must be of the highest quality. Concerning the latter, it is desirable that they have speeds of 7½ ips for their professional applications, and some lower speeds for those applications where they will be required to record for longer periods of time. It is also desirable that they accommodate 7-in. reels with the cover on, and their operating characteristics must be comparable to studio-type machines. All these attributes are offered in the Sony TC-770, the only sacrifice being in the weight department. The model tested was the TC-770-2, which records and plays two tracks, and by throwing a switch, additionally plays four-track tapes. The TC-77-4 records and plays four-track tapes, and the switch permits playing two-track tapes. Fig. 1 shows a typical 770, while Fig. 2 shows the recorder with the top plate removed.

Fig. 1. Sony TC-770-4 portable tape recorder. The 770-2 model is identical in appearance except for the number on the nameplate.

The unit is a handsome device, with its pebble-grained black covering and chrome hardware. The inside reveals a chrome metal plate, with reel hubs which accommodate 7-in. reels, two tension rollers, and the capstan and idler. The head cover is a casting which slips over two slotted pins for location, and locks in place with a thumb screw at its rear. On the sloping front panel are — from left to right — two monitor push/push buttons to select source or tape monitoring. Below these is the power switch, and the inside of the case is fitted with a plastic projection which prevents the top being put on unless the switch is in the OFF position. To the right are the two VU meters, with the record-level controls below them. These are dual concentric knobs, with the smaller one for microphone input and the larger for auxiliary input. Next to the right is a black button which provides a battery test when depressed — the VU meters deflect to an indicated portion of their dials — the left one for the 7½-V amplifier battery and the right one for the 10-V motor battery. The track selector switch is on the head cover. Next are two red RECORD buttons which must be depressed at the same time as the FWD key to start recording. Recording level may be adjusted without running the machine simply by depressing the monitor buttons for SOURCE. With these buttons up, monitoring is from the tape, and the meters indicate the recorded level on the tape. At the right are the four function keys—REWIND, FAST FORWARD, FWD, and STOP. These are interlocked so the FWD key cannot be depressed while the fast-wind keys are down without first depressing the STOP key.

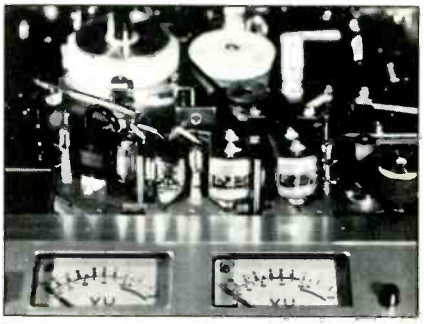


Fig. 2. The recorder with the top plate and head cover removed.

The front panel compartment is accessible by opening a hinged door downward. In it are the "SNR"—Sony-Matic noise reduction—switch, shown

in Fig. 3. Near the center are three push-push switches which select the speed—7½, 3¾, 1⅞ ips. Next is the limiter switch, then the speed-tuning knob. In its normal pushed-in position, the speed is fixed at the specified value. Pull it out and rotate it to the right for faster operation, or to the left for slower, on playback only. This switch is disabled in the recording mode. Next come two playback control knobs which set the output level. Above them, and visible with the hinged cover closed, are the power indicator lights—one for a.c. and one for battery.

In an opening on the right side of the case are two sockets—one for the a.c. line plug or the 12-V battery cable plug, and another—a DIN socket—for the remote control cable, which is a furnished accessory. In a similar opening on the left side, are the two Cannon microphone receptacles, two phono jacks for auxiliary inputs, and two more for line outputs. A compartment at the back holds the battery pack, which plugs into the unit by means of another DIN plug. All connections to the battery pack are made with this plug. The batteries are of the nickel-cadmium type, and they run the device whenever it is turned on, even though the a.c. plug or the 12-V plug is in place. The battery "floats" on the incoming power supply, and may be charged from the a.c. line with the power switch off.

The limiter circuit mentioned previously serves as a controlled voltage divider, and affects distortion minimally. Even with 30 dB of compression, the distortion is still a respectable 1.2%. This is practically unheard of in any compressor or limiter which has been measured by us heretofore.

The variable speed control will vary speed (on playback only) about ±5% from normal, which is more than adequate for any situation likely to be encountered. The SNR control will add a comfortable 6 dB to the S/N, and all without affecting frequency response. The circuit is essentially the same as used in the TC-666D, described in these pages in the February issue.

In all, the TC-770 series uses 55 transistors and 39 diodes. Thirty transistors are used in the amplifying section, 4 in the bias-oscillator section, 5 in the SNR circuit, 13 in the speed-control section, and one in the power supply. In addition, there two more which control the power-indicator lights. If running on battery alone, one light is on, lit by the collector current of one transistor. If the a.c. plug is in, there is an a.c. voltage applied to the base of the second transistor (through a diode), and its collector current lights the lamp, at the same time shutting off the first transistor and extinguishing the battery lamp. If you are recording with the a.c. line and power fails or the plug is pulled out, there is no change in speed nor any click—the machine continues to run without a flicker. Only the lights change.

A single d.c. motor operates the transport. On its shaft is an a.c. generator which furnishes the signal to the control circuits. These circuits are factory adjusted to provide any of the three speeds with an accuracy better than 2%.

One of the tension rollers actuates a microswitch so that power to the motor is shut off when the tape runs out. The other simply keeps tension on the feed reel, and, with the scrape-flutter filter in the head assembly, completely eliminates scrape flutter, which is present in some machines.

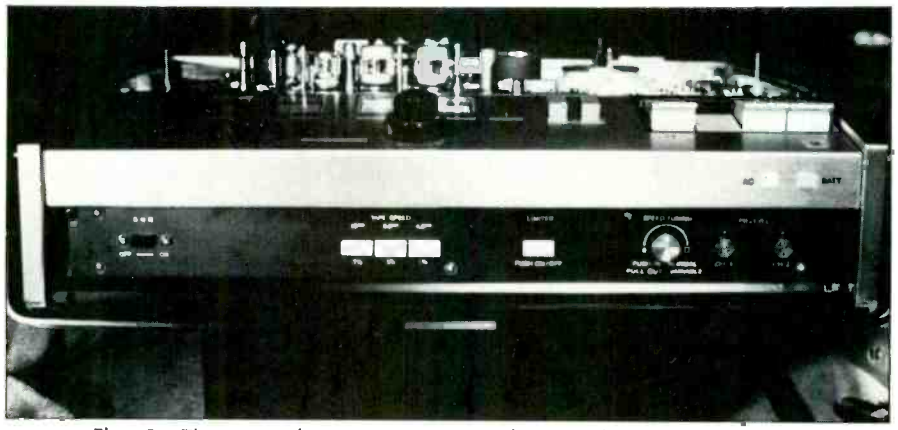


Fig. 3. The open front compartment showing the auxiliary controls.

Performance

Figure 4 shows the frequency responses of the TC-770 to standard tapes at 7½ and 3¾ ips, as well as record/playback responses at all three speeds. Note the dotted curves for each speed. It is our usual practice to use Scotch 202 tape for these measurements, and the dotted curves show the responses with this tape. The 770 instructions say that it is aligned and biased for a more standard tape, naturally Sony PR-150. Inasmuch as the response with 202 was not within specifications, we requested a roll of Sony tape and remade the measurements, with the results shown in the solid lines. This does not indicate that anything is wrong with the machine—only that its bias was set for the Sony product. The same results were obtained with the more common 111, which is most similar to Sony PR-150. Certainly for the 7½ and 3¾ speeds, we would recommend the Sony tape, while for 1⅞, it appears that the 202 might give better high-frequency response *at the standard bias settings*. This is the first time these results have been plotted in a Profile, and it may give the reader some insight as to the importance of correct bias settings for each type of tape. The bias frequency was measured at 168 kHz, which would certainly permit recording as high as 34 kHz without interference or beating with the fifth harmonic of the signal, but more important, the bias is not likely to beat with any harmonic of the 38 kHz used in multiplex stereo circuits. Of course, you might get a 14-kHz beat with the fourth harmonic of the 38, but it seems most unlikely, even if the fourth harmonic were strong enough to beat with anything.

Wow and flutter measured .08% at 7½ ips, .09 at 3¾, and 0.16 at 1⅞, all better than specifications. S/N measured 59 dB without and 65 dB with SNR at 7½, and only at 4 dB less at 3¾. The 3% distortion point occurred 10 dB above the indicated 0 dB on the meter scales, with distortion around 1.2% at all frequencies from 50 to 10,000 Hz at the indicated 0-dB level. The microphone input signal required to get a 0-dB level was .04 mV with the control at maximum, while 46 mV would produce the reference level from the auxiliary input. The output at the line terminals was 0.775 V at the same level, and the monitoring output for 8-ohm phones was 54 mV, which provided a comfortable listening level. Note that the limiting action, shown in Fig. 5, indicates no increase in distortion over a wide range of input signals, and that the limiting—or rather, compressing—action was very effective.

All of the operating controls work smoothly with no hitches. For editing, the head cover is readily removable, giving good access to the heads them-

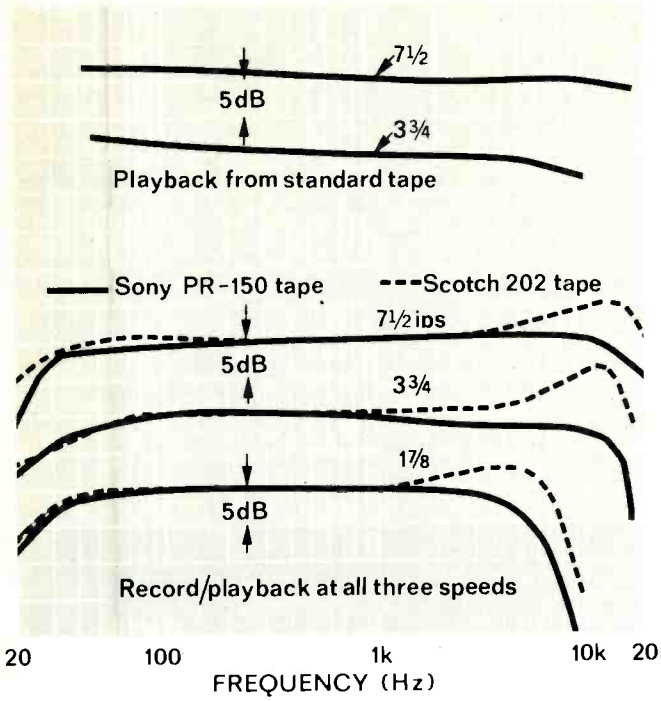


Fig. 4. Performance curves: Upper pair show responses to standard-frequency tapes. Lower curves show record/play responses with Sony PR-150 tape (for which the machine was biased) in solid lines, and with Scotch 202 tape in dotted lines.

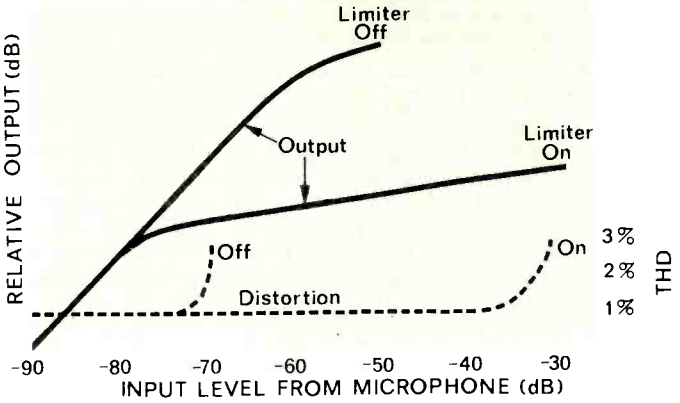


Fig. 5. Limiter-compressor characteristics: Solid lines show relative outputs for the wide range of microphone input signals with the limiter on and off. The dotted curves show the distortions under both conditions.

selves. They are completely exposed with the cover off, and the usual grease-pencil markings can be applied exactly at the head gap—making sure to use the correct head for the track configuration you are using. The remote control previously mentioned will start the transport at a distance, leaving the mode—recording or playback—undisturbed. It will not permit remote rewinding or fast forward winding, but that is rarely needed from a remote location anyhow.

The machine's speed accuracy holds well until the battery voltages are below the limits marked on the meters, which ensures that recordings made in the field will be compatible with those made in the studio.

In evaluating the total Sony/Superscope Model 770, one must concede that it is not a machine you would carry around as you would a cassette recorder. It weighs too much for that application. Since it is a professional machine with important extra features and 7-in. tape reel capacity, it should be viewed in that light. As such, its 25 lbs. appears to be amazingly light. In fact, we would view the Sony/Superscope Model 770 as a superb tape deck even if it were an a.c.-only machine. With a built-in battery power supply and a stereo system that maintains accurate speed, Sony has surely developed an exceptional unit that fills a niche sorely needed by professionals and other serious recordists. And if $750 sounds like a lot of money, remember that you're getting a portable that can also be used as a no-compromise a.c. tape deck. An added fillip is a marvelous instruction book that includes a complete schematic.

Check No. 45 on Reader Service Card

H. H. Scott Model LR-88 Stereo FM/AM Receiver Kit

Fig. 1—Front view of the H. H. Scott LR-88 receiver kit, after assembly.

MANUFACTURER'S SPECIFICATIONS:
FM Tuner Section. IHF Usable Sensitivity: 2.5 μV. S/N Ratio: 65 dB. Capture Ratio: 2.5 dB. IHF Selectivity: 45 dB. Frequency Response: 50 to 15,000 Hz ±2 dB. Cross-Modulation Rejection: 80 dB. Total Harmonic Distortion (Mono): 0.6%. FM Stereo Separation: 35 dB @ 400 Hz. **AM Tuner Section.** Sensitivity: 200 μV (built-in antenna; 9 μV (ext. antenna). **Amplifier Section.** Dynamic (IHF) Power Output: 80 watts total at 8 ohms. RMS Power Output: 30 watts per channel at 8 ohms. THD: 0.6% at rated output; 0.4% at 15 watts rms/channel. IM: 0.8% at rated output; 0.6% at 15 watts rms/channel. Frequency Response: Tape, Extra: 20 to 20,000 Hz ±1.5 dB. S/N Ratio: Tape, Extra: 80 dB; Phono: 65 dB; Tone-Control Range: Bass: ±10 dB @ 50 Hz; Treble: ±10 dB @ 10 kHz. Power Bandwidth: 20 to 20,000 Hz. Damping Factor: 30. Dimensions: (completed unit) 17½" W x 15" D x 5½" H. Price: $334.95.

Here's a stereo FM/AM receiver *kit* with a real hot front end, fairly high power output, low distortion, and excellent operating flexibility. Besides that, it's a good-looking unit when assembled; no "kit look" to this one. And assembling it yourself saves money.

Most of the kit-building consists of mechanical assembly of parts, and wiring output transistor circuitry, selector-switch, and all of the interconnecting cables between the various p.c. boards. A view of the underside of the chassis, after completion, is shown in Fig. 2. All but one of the p.c. assemblies can be seen in mounted position. The H. H. Scott silver-plated, FET front end comes completely wired and aligned. In all, the Model LR-88 has a total of 34 silicon transistors, 24 diodes, 4 integrated circuits and 2 stabistors.

Our kit builder was asked about con-

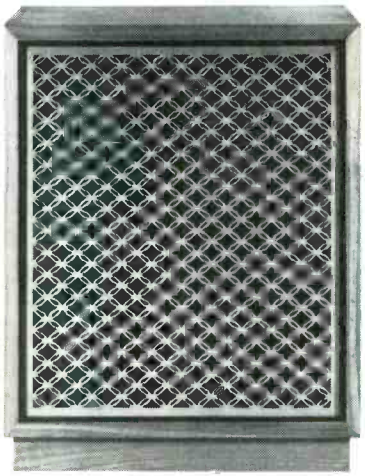
There's more to the new Marantz speaker system than meets the eye.

(Lend an ear.)

Today, Marantz once again expands its reputation for audiophonic excellence with the introduction of a new concept in speaker systems.

After years of experimentation, Marantz' first two Imperial Speaker Systems are now ready to be enjoyed by discriminating connoisseurs.

Technically, both feature a three-way design incorporating five speakers in an enclosure only slightly larger than a standard book shelf speaker. Yet, the power and quality of the sound they deliver are comparable to theatre speaker systems not only twice their size but many times their cost. The sleek, contemporary Imperial I has a smart, walnut cabinet with a hand-rubbed French lacquer finish and is priced at $299.00. The elegant Imperial II, hand-crafted from selected hardwoods and finished in distressed antique, features a stunning hand-carved wood grille. It's yours for $369.00. Both possess a beauty of cabinetry equalled only by the beauty of their sound.



When you hear, when you see these magnificent speakers, only then can you fully appreciate what goes into making a Marantz a Marantz. Your local franchised Marantz dealer will be pleased to furnish you with complete details and a demonstration. Then let your ears make up your mind.

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THE SOUND OF MUSIC AT ITS VERY BEST.

struction of the kit, so before we deal with the "finished product," here are his comments:

"Instructions were excellent . . . This kit displayed exceptional design and packaging concepts . . . color diagrams were easy to follow. Parts were delineated by construction number and beautifully packed in foam separators. Solderless connectors helped considerably where used."

Minor difficulties encountered were: ". . . some screws had stub ends instead of pointed (self-tapping type) and were hard to start in self-tapping holes. One wire length was missing."

Pre-cut and pre-stripped wire, with critical sections being pre-wired and pre-aligned, plus liberal use of printed-circuit boards, simplifies construction. And Scott's use of built-in meters for alignment purposes, makes it all so easy for the non-pro. It took our builder, who was admittedly meticulous about everything, a total of 45 hours to finish the stereo FM/AM receiver kit.

The instruction booklet, by the way, is far more than just an assembly and wiring manual. Pages 28 through 67 in this 152-page book are actual step-by-step instructions. Other sections include general kit construction tips, a detailed parts list, test procedures and alignment (without the need for any test equipment), installation and operating instructions, a section on AM/FM receiver theory (fully twelve pages), technical service instructions, and a station log and custom-mounting template (full size).

The Completed Receiver

The photo in Fig. 1 shows the front panel of the LR-88. The upper half of the panel is black, disclosing a well-lighted dial scale only when the unit is turned on. Two tuning meters are at the left, one for center-of-channel tuning of FM stations, the other for peak signal indication while tuning in FM and AM stations. The expanded FM scale has marks for every MHz, and they are extremely accurate, deviating from true frequency by less than a "pointer width" at all points on the dial. An equally well-calibrated AM and logging scale are provided. To the right of the dial scale is a tiny red spot of light, illuminated in the presence of a stereo FM signal; to the right of that is a nicely balanced flywheel tuning knob.

The lower half of the panel is in anodized gold color and contains all the other controls. A pair of microphone jacks are at the extreme left. These are followed by a five-position selector switch (mic., phono, FM, AM and Extra), the usual balance control, clutch-type dual bass and treble controls (each channel's tonal response can be individually adjusted) and a loudness control which, in its counterclockwise position, turns off power to the entire unit. We wish power on-off had been accomplished in some other manner, say by means of one of the push-buttons at the lower right of the panel. As it is, there are seven of these button switches for such secondary functions as loudness on/off, tape monitor, mono/stereo, noise (high-frequency) filter, FM muting, remote speakers on/off and main speakers on/off. A stereo headphone jack completes the front-panel layout.

The rear connection panel, shown in Fig. 2, has two a.c. convenience receptacles (one switched, one unswitched); a line fuse, as well as individual channel speaker fuses; antenna terminals for FM, as well as a terminal for external AM antenna; speaker terminal strips (barrier type, to prevent accidental shorts); a phono sensitivity switch (either 4-mV or 7-mV sensitivity for full output); tape input and tape output jacks; an access hole for the muting threshold adjust (variable from 3- to 30-μV sensitivity. And there's a new feature we haven't seen on a complete receiver before: a small slide switch alters the remote-speaker output terminals from stereo channels to a monophonic mix of left and right channels. This strikes us as a very good idea, in that it permits the mounting of a *single* remote speaker in another room (or even one in each of two secondary locations) and, when thrown to the "mono" position, affords a compatible mono mix of program material while the main speakers continue to provide full stereo. Another suggested use (by Scott) is the possibility of using a single remote speaker as a fill-in center channel for overly separated program material or two widely spaced main speakers (because of decor necessity). In such cases, a single remote speaker is connected to either set of remote speaker terminals, the mono-stereo remote speaker switch is set to "mono," and this single speaker then can be placed mid-way between the two main speakers to provide the needed third-channel fill.

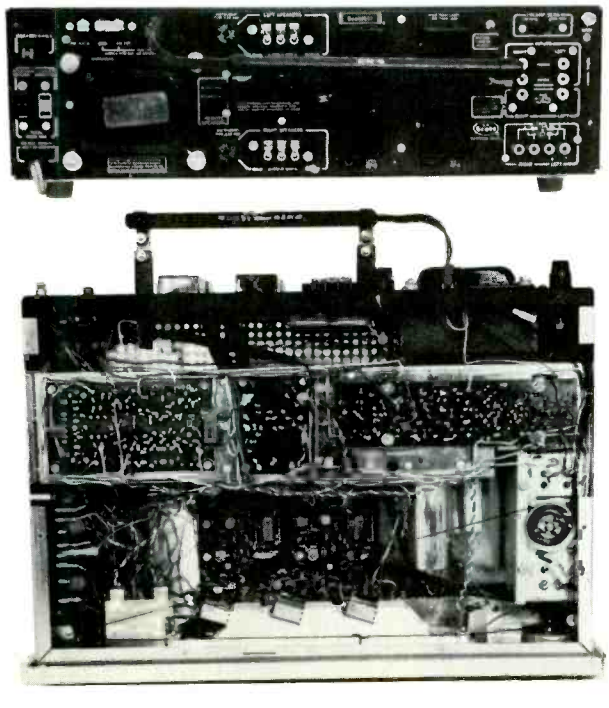

Fig. 2—Rear panel and underside view of the LR-88 receiver. The latter shows extensive use of pre-wired, printed-circuit boards.

The AM loopstick antenna is plugged into an appropriate socket at the rear, so that it can be disconnected (and even removed entirely together with its protruding brackets) in the event that an external antenna is used for AM. The output transistors are mounted on the rear surface, too, as is common. Suitable protective covers are used to prevent access to these devices, which carry voltage on their cases.

Performance Measurements

We have long maintained that IHF sensitivity alone does not tell the complete story concerning a product's performance as an FM receiver. Here is another case in point. Although the

Marantz announces the end of distortion.

(And the beginning of the new-generation IC amplifier.)

For the first time in audiophonic history, the all-new Marantz Model 16 stereo power amplifier brings to music lovers distortion-free amplification.

Marantz' new-generation integrated-circuit amplifier eliminates intermodulation and harmonic distortion to such an infinitesimal degree it cannot even be measured by conventional test equipment!

The first in a new-generation series of stereophonic equipment from Marantz, the Model 16 RMS eighty-eighty stereo amplifier represents a significant advance in the state of the art. It features exclusive separate power supplies for total isolation of each channel. This means there is absolutely zero cross-modulation distortion. Now for the first time, you hear individual instruments. Distinctly. Without annoying cross-talk from instruments reproduced from the other channels. There is absolutely no sound leakage between channels. When you listen to music through the Marantz Model 16, you will be listening to the purest, cleanest sound ever achieved by any amplifier.

The new Marantz Model 16 stereo amplifier RMS eighty-eighty means just that: 80 watts delivered per channel. (RMS means continuous power—from the lowest to the highest reproduced frequency. Not the "dynamic" or "peak" or "music power" that other manufacturers quote in their specifications. When Marantz quotes 80 watts, Marantz means 80 watts. Period!)

To truly appreciate how infinitely superior the $395.00 Marantz Model 16 stereo amplifier is, we suggest you visit your local franchised Marantz dealer. He will be pleased to furnish you with complete details together with a demonstration. Then let your ears make up your mind.

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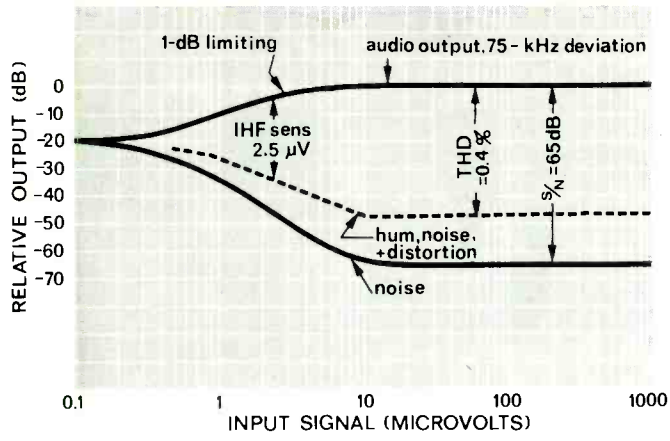


Fig. 3—FM (monophonic) characteristics of the LR-88.

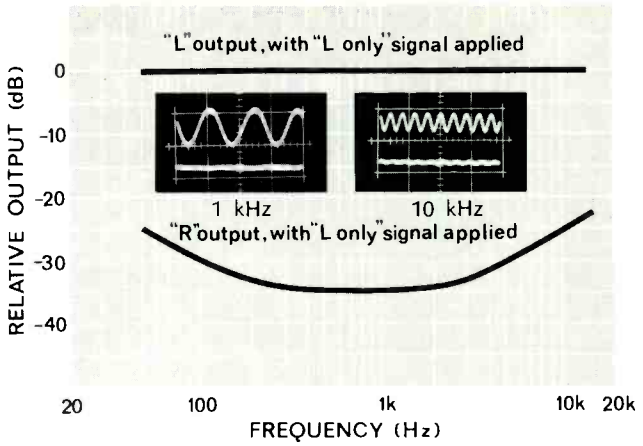


Fig. 4—Stereo FM separation, with 1 kHz and 10 kHz dual-trace photos.

Fig. 5—Total harmonic distortion and intermodulation distortion of the LR-88 receiver vs. power output (rms watts).

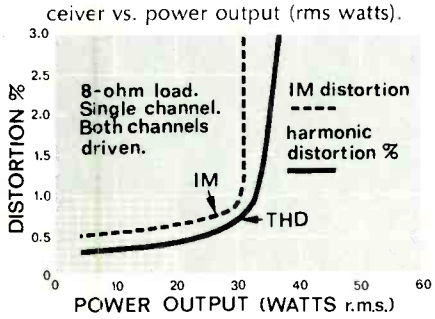


Fig. 6 — Power bandwidth (½ power) stretches from 18 Hz to 23 kHz. Square-wave response at (A) 100 Hz and (B) 10 kHz is also shown.

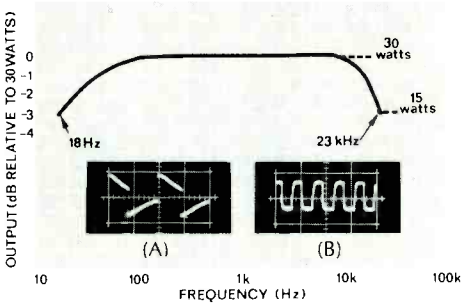
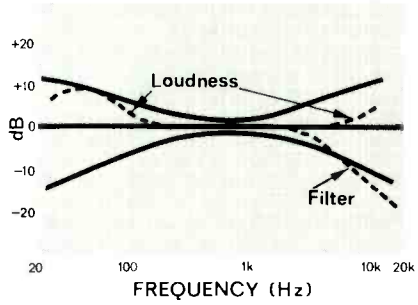


Fig. 7—Tone control, loudness, and high-frequency filter action.



Scott people claim a sensitivity of 2.5 μV, and our sample come close to it as shown in Fig. 3, actual FM performance seems better than that. For example, we logged no fewer than 43 FM stations with adequate quieting, using only an indoor dipole antenna. Of these, 15 were in "listenable" FM stereo. When we switched to an outdoor Yagi antenna, with the aid of a rotator, we were able to pick up a grand total of 51 usable stations (at least 30-dB rejection of noise and distortion) and the stereo number increased to 17. All this in a suburban New York location. Now, 2.5 μV IHF sensitivity is not the lowest ever measured in our labs, but this is a new record for number of stations received.

The feat is all the more remarkable when you remember that the kit builder did not have access to a single piece of professional test or alignment equipment. Whatever alignment was needed was done simply by following the EZ-A-LIGN® procedure given in the Scott manual. Essentially, the tuning meters of the finished receiver serve as the necessary indicators during this ingenious alignment procedures. Other relevant FM characteristics are also shown in the composite graphs of Fig. 3. It should be noted that while THD in mono was actually better than claimed (0.4% instead of 0.6%), it did reach 1.0% in the stereo (no manufacturer's spec given). Signal-to-noise was exactly 65 dB, as stated and full limiting occurred at an input of only 3 microvolts.

As for amplifier performance, the manufacturer's specifications were easily met or exceeded. For example, rated distortion was reached at 32 watts r.m.s. per channel, as compared with 30 watts claimed. THD with an eight-ohm load, as well as IM distortion, are shown in Fig. 5. Power bandwidth, shown graphically in Fig. 6, is seen to extend from 18 to 23,000 Hz; again, better than manufacturer's claims if one bases the measurements upon 30 watts rms per channel of full output. Tone-control action is illustrated in Fig. 7, in which the loudness compensation characteristic as well as the high-frequency filter action is indicated. It must be pointed out that this filter is not very effecive because of its limited slope (6 dB per octave), which acts like little more than an auxiliary treble control with a slightly shifted cross-over point. Square-wave response at 100 Hz and 10,000 Hz, shown in Fig. 6, is typical of most all-in-one receivers, and is deemed to be adequate.

Scott multiplex decoder circuits are noted for their sophisticated and excellent design, and the one built into the LR-88 is no exception. Particularly noteworthy is the fact that separation of at least 25 dB between channels is maintained from 50 Hz to 10,000 Hz, with fully 35 dB of separation measured at mid-band frequencies, as shown in Fig. 4. Accompanying photos taken of a dual trace 'scope screen visually confirm the meter measurements. Threshold of switching from mono to stereo FM is positive, and occurs at about 4 microvolts of r.f. input signal. At this minimal signal level, stereo performance is fairly noisy, of course, but the mono-stereo pushbutton switch enables the user to defeat the automatic switching feature and listen to such marginal stations in a mono mode. When the switch is depressed to mono, the stereo indicator light is extinguished, to remind the user that he is *not* listening in stereo, station announcements notwithstanding.

All in all, if kit building is your forte (or even if you've never tried it for fear of possible complexity), the Scott LR-88 offers a most competent design at a price well below that for an equivalent factory-assembled unit.

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Take our SE-50 (*so many of you have!*), its quality literally speaks for itself. We've miniaturized Big Speaker System design and sound into each of its lightweight, comfortable, vinyl covered earcups. It features cone-type woofers and mylar-diaphragmed tweeters, resulting in extraordinarily smooth response from 20 Hz to 20 kHz. The SE-50's performance and features, at only $49.95 are in a class by themselves. *That sounds astounding, but so does the SE-50!*

The Pioneer SE-20 ($19.95) and the Pioneer SE-30 ($29.95) equal and surpass the performance of headsets far more costly, and every Pioneer headset is supplied complete with its own permanent storage case. Pioneer has a reputation to live up to, and these headsets are fine examples of how we go about it.

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Rabco SL-8 Servo-Driven, Straight-Line Tone Arm

MANUFACTURER'S SPECIFICATIONS: Dimensions: 3¾" high (adjustable); 14" long. Weight: 3 lbs. Tracking Force: ¼ gram minimum. Servo System: Crossed-wire precious metal contacts operate a precision servo motor through a single-transistor amplifier. Lift at end of record is automatic. Power supplied by a standard "C" cell. Battery life roughly equivalent to shelf life. Pickup mounting: Cartridges with standard ½" spacing mount with two screws. Holder can be adapted to any other spacing. Cartridge holders are interchangeable. Output connections: Standard phono jacks provided on the frame. 3-ft. cable supplied. Price: $149.50. Accessories described in text.

Here's a phono cartridge tone arm for audio buffs who can put their money where their hearts are. It's a straight-line-tracking tone arm for manual turntables. A servo drive system inhibits the tone arm from moving in an arc while the cartridge moves inward on the disc being played. By moving in a straight line toward the center of a record, the tracking-angle error exhibited by conventional tone arms is eliminated.

As everyone who has ever seen a professional disc cutter in operation knows, the head is carried on a lathe which moves the cutting stylus along the radius of the recording blank. It would thus seem obvious that the way to move the playing cartridge would be exactly the same — along the radius. While the problem was solved by Edison around 1895 by driving the playing stylus along a cylindrical record by means of a threaded rod—just as, in effect, the current recording equipment operates—it has not been so simple for reproducing a disc record, which may be cut anywhere from, say, 80 grooves per inch (for a 78) up to about 250 for an LP.

Those who have followed hi-fi for years have seen several different devices designed to maintain perfect perpendicularity to the radius of the record along which the stylus moves, regardless of position of the arm (the B-J arm, for example), and the lateral-moving cartridge holder of the Bard arm, which depended upon the stylus itself to impart the necessary motion to the carriage. Neither of these is still on the market. In the case of the B-J arm, the many additional pivots caused too much friction to be overcome by modern light stylus forces, and the high compliance of modern cartridges proved too much for the Bard, although both of these configurations had their advantages which were apparent when stylus forces were in the 3- to 5-gram range.

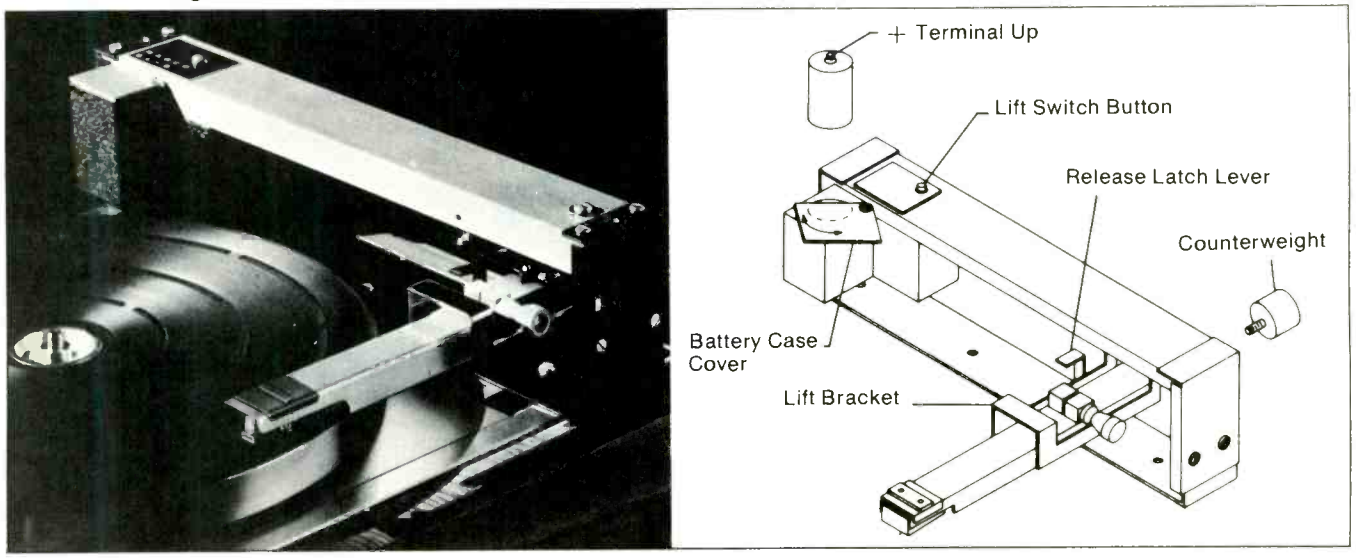
As recently as May, 1966, the Servo Groove Tracker was presented in these pages almost as a home construction article, and about the same time another article was submitted, but rejected in favor of the one which appeared under the authorship of Arthur G. Johnson.

The requirements are well known—the arm should move laterally along a track parallel to the radius of the record so that the cartridge is constantly perpendicular to the radius, and it should either move so freely as to be impracticable from the construction standpoint, or it should be moved by a servo mechanism. To avoid any mechanical drag on the arm or carriage, Mr. Johnson suggested a lamp which illuminated either of two photocells, depending on the position of a mask. The idea would have worked perfectly, although the device would have been unduly complicated.

The Rabco SL-8, however, employs a simpler geared-down d.c. instrument motor, and the contacts are precious metal wires which exert a minimum of "drag" on the carriage.

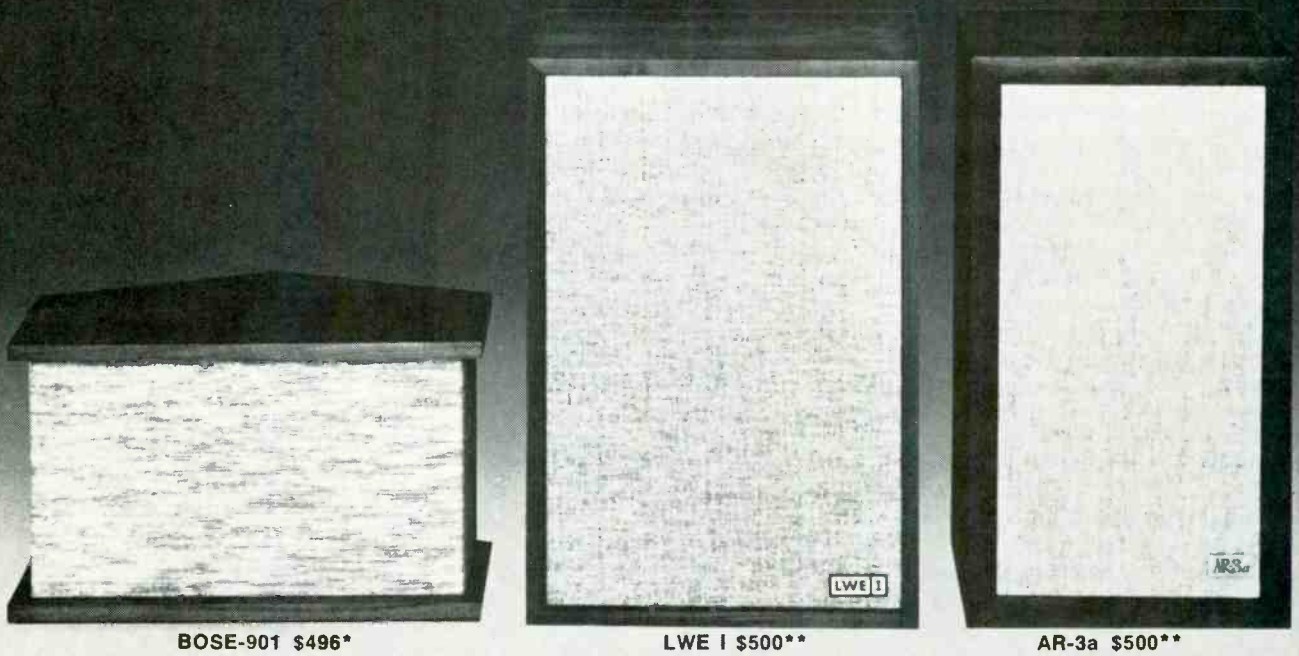
The arm itself is counterweighted, and swings on two sets of pivots—the horizontal ones being just as close to the record surface as possible, which is considered good practice. The vertical pivots are directly under the center of the carriage, which rides on four nylon rollers that travel along the main channel—an extruded aluminum channel. The lift bracket controls the raising of the arm, and when the arm is in the raised position, it is centered by the duo-conical shape of the clamping screw which holds the tubular cartridge-holder end in place. When the lift bracket is depressed, the stylus lowers to the record surface, and at the same time the carriage is clamped to the ball-chain driving loop. An extension from the arm carries a 30-mil gold wire in a vertical plane. Any inward movement of the arm with respect to the carriage causes the gold wire to contact a thin spring wire of platinum alloy which energizes the transistor amplifier and drives the servo motor—a Swiss instrument type geared down so that it takes 90 sec. for it to complete one revolution. This motor, the amplifier, the battery, and the output terminal strip are all mounted in a cast aluminum housing at the left end

Fig. 1. The Rabco SL-8 arm mounted on the Thorens TD-150 turntable, and drawing with parts callouts.



Which of these comparably priced, top-quality speakers utilizes the new principle of electronic suspension?

only LWE.



BOSE-901 $496* LWE I $500** AR-3a $500**

For years now inverse (negative) feedback has been used in Hi-Fi amplifiers to improve performance. Recently LWE research has uniquely adapted the same principle to control the speaker cone electronically at all times — resulting in dramatically improved speaker performance. No resonant mechanical or acoustic mass-spring system can influence low frequency response. Transient response is unrivaled. Room Gain Control is provided to compensate for room acoustics.

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LWE speakers are available in four basic sizes to meet the power and space requirements of any room. You choose from a wide variety of woods and finishes, as well as unfinished kits. LWE prices range from $75 to $3,000 and include LWE's standard five year speaker guarantee. Hear the LWE at your dealer or write for LWE's "Sound of Excellence" Brochure.

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*Manufacturer's suggested retail price for twin speakers and "Equalizer." ** Manufacturer's suggested retail price for twin speakers. Single speaker is $250.

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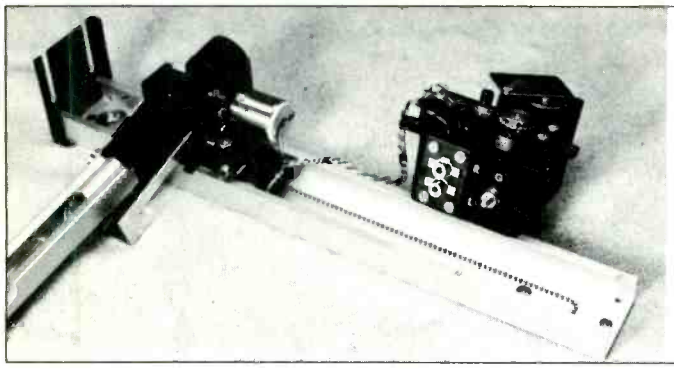


Fig. 2. The working parts of the arm inverted to show the construction, together with a close-up of the amplifier/servo motor housing.

of the track. The motor is fitted with a pulley which is grooved to fit the ball chain, and the other end of the chain loop feeds over a nylon pulley at the right end of the track. Most of these details can be seen in the accompanying figures.

At the end of the record, the arm moves more rapidly because of the run-out groove, and the gold wire contacts a second platinum alloy wire which energizes a second motor on the carriage to release the lift bracket, thus raising the cartridge from the record. If the user wishes to lift the arm before the end of the record, he depresses the release latch lever on the carriage which mechanically lifts the arm, or he depresses a red button on the top of the motor housing which energizes the lift motor. The "C" cell fits into the casting and is held in place by a cover which also serves to make contact with the positive pole of the battery.

The Rabco arm must be mounted directly on the motor plate, or on some part of the turntable structure that moves as the platter does. Thus it is suited for use with the Thorens TD-150 table, on which the test sample was installed. This turntable provides the needed spring mounting from the base, yet provides a place for mounting an arm so it will be rigid with the turntable, for no relative movement between the arm and the center of the platter can ever be permitted. Several Thorens models should accommodate the Rabco arm nicely, and the ingenious experimenter could undoubtedly figure out some way to mount it on other turntables.

Performance

Without question, the Rabco arm does what it is supposed to do, and does it nicely. There is sufficient latitude for the arm to sway slightly enough to accommodate minor eccentricities of the record movement without energizing the servo motor, but even if it did, the arm would only move slightly in the proper direction and then stop and let the cartridge "catch up." Then the cycle would start all over again.

Obviously, there is no skating—since skating is the result of the geometry of angled arms and their overhang positions—so no anti-skating provision is necessary. And because the only work the stylus has to do—other than track the groove and wiggle its magnet or its armature so as to produce the signal—is to move the arm against the fine platinum alloy spring wire, the cartridge is able to track at usually well under the cartridge-manufacturer's specification. The Shure V15-II, which was fitted on our test sample, would track anything we gave it at ½ gram, and if we sat still and didn't walk around on the not-too-solid floor, it would track at ¼ gram on most material. Some heavy modulations would not come through as they should, so we would recommend ½ gram as the minimum for this cartridge, assuming a solid flooring.

The driving motor can barely be heard by placing the ear close to the track, but could not be heard through the reproduction at all. At first we thought that some form of dashpot would be desirable to slow the dropping of the stylus to the record, which seemed to be rather abrupt, but dropping a half-gram a quarter of an inch (at most) couldn't possibly hit very hard, so we quit worrying about that.

The track is readily adjustable to any platter height, and stylus force is adjusted by turning the counterweight one full turn for each gram of force desired, after balancing the arm completely. The counterweight has a marker on its back so as to permit accurate adjustment.

Our only suggestion for a change, after rejecting the few other ideas we first had, would be to color the release latch lever red instead of the yellow now used. The electrical release button is red, and the yellow is jarring, in our opinion. We know the principle is right, and we must admit that the embodiment of the finished product works perfectly, as far as we can see. It is a delightful device.

As mentioned, our test sample was fitted with a Shure V15-II cartridge, and it was mounted on a Thorens TD-150. Factory fitted, the cartridge is an additional $67.50, and the table is an additional $85.00. The base, in oiled walnut, is another $12.00, making a total of $314.00 for the complete assembly. Additional plug-in cartridge holders are $7.50 each, for those who must have a number of cartridges ready to use.

This is not inexpensive, but you get a lot for your money: minimized record and stylus wear, superb reproduction, and perfect anti-skating compensation (since none is required).

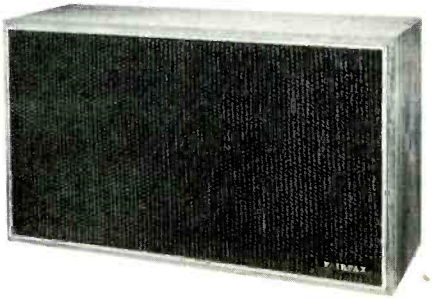
Check No. 134 on Reader Service Card

Fairfax Bookshelf Loudspeaker System, Model FX-100

MANUFACTURER'S SPECIFICATIONS:
Two-way system. Woofer—8 in. dia. ducted port; Tweeter, 3½-in. cone. Crossover frequency: 5500 Hz. Frequency range: 30-20,000 Hz. Power Handling Capacity: 30 watts. Impedance: 8 ohms. Dimensions: 21″ x 12″ x 8″ deep. Weight: 24 lbs. Price: $89.50.

This new compact bookshelf model employs two speakers in a ported reflex cabinet which differs from most other ported cabinets in that the port tube is cut off at an angle of about 45 deg., rather than perpendicular to its length. The tube itself is 2½ in. in diameter, 4½ in. long at its longer dimension, and 2 in. long in its shorter. This form of port should tend to smooth out the lower end of the spectrum, much in the same manner as an exponential horn does if it is large enough to reproduce lows. The speaker puts out a good level at 60 Hz, without doubling, and a measurable output up to 22,000 Hz, although it is down considerably at that frequency, as one would expect.

Fig. 1—Fairfax FX-100 Loudspeaker system.



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match your auto-turntable to the quality of a Sherwood 6000

The No-Compromise "Sound Center" for Limited Space.
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*Any of the Dual (current models) or Garrard SL55 or SL65.

Equipment Profiles (continued)

The impedance of the system shown in Fig. 2, measured relatively smooth from 150 to 20,000 Hz, varying from 6 ohms at 5500 Hz (the crossover frequency) to 10½ ohms at about 1200 Hz. The two low-frequency peaks are at 90 and 23 Hz, respectively, with impedance of 20 ohms at the higher and 24 ohms at the lower-frequency peak.

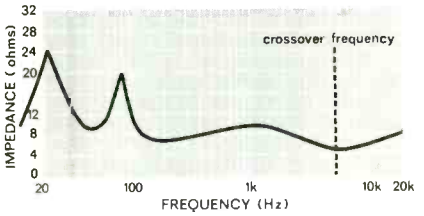

Fig. 2—Impedance curve measured at the terminals of the FX100.

It has been our experience that when the lower peak (there are always two in a reflexed speaker system) is the higher, the speaker tends to give the impression of having more "low bass" than it does if the lower-frequency peak is lower in impedance than the upper peak. That impression is borne out in listening when the speaker is on the floor. Raise it off the floor and it apparently loses some of its lowest response.

We found the terminals on the speaker input strip to be too closely spaced. Thus the user should avail himself of spade terminals for making connections to avoid the possibility of a single strand of the connecting cable shorting to the adjacent terminal, with the consequent possibility of damaging the amplifier output transistors (or at least blowing fuses). The high-frequency level control, also mounted on the terminal board, provides for an adjustment of treble response to accommodate the room environment over a range of about ±3 dB, which is adequate for normal installations. Any more than that and the user should consider taking another look at his furniture, drapes, and so on.

We tried FX-100s on a wide variety of program material, including both male and female speech, and found them within the usual limits of bookshelf-size speakers in its price range—that is, with a falling off of the lower bass frequencies, and with a loss in high-frequency response at more than 30 deg. off axis of the tweeter. There is a slight chestiness in male voices, indicating a bump in the response in the 100-150 Hz range. The tone-burst photos, shown in Fig. 3, indicate fairly good transient response and little hangover, both in the 1000-Hz bursts at (A), and in the 6000-Hz bursts at (B).

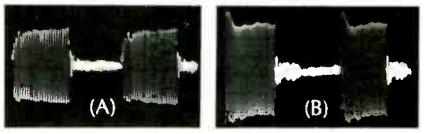

Fig. 3—Tone-burst response at (A) 1000 Hz, and (B), 6000 Hz.

Assuming, therefore, that the speakers are placed on the floor or in a bookshelf near an adjacent wall, the FX-100's would be a good choice at $89.50 each. They are efficient in comparison to the average acoustic-suspension types, and show no objectionable peaks throughout their range. Concerning the former, one need not have a powerhouse amplifier to drive it satisfactorily; a ten-watter would be adequate. And the absence of major peaks in response gives the Fairfax-100 an overall listening quality that could be described as smooth, with a balance between lows, midrange, and highs that has been well chosen.

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This is the A-6010U, top of the TEAC tape deck line. And these are just a couple of its supersonic breakthroughs: Unique **phase sensing auto reverse** operates electronically at any chosen point on the tape. Or it can take a sensing foil if desired. But don't look for this system on anybody else's machine. Separate heads for record and playback allow **off-the-tape monitoring while recording;** most other machines in this price range can monitor the sound source only.

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CLASSICAL RECORDS
Edward Tatnall Canby

(Continued from page 14)

Schoenberg: Transfigured Night. Vaughan Williams: Fantasia on a Theme of Thomas Tallis. Strings of the N. Y. Philharmonic, Mitropoulos. **Odyssey 32 16 0298 (sim.) stereo** ($2.50)

Schoenberg: Transfigured Night. Loeffler: A Pagan Poem. Leopold Stokowsky and His Orchestra. **Seraphim S 60080 stereo** ($2.50)

Transfigured Night (Verklaerte Nacht), composed in 1899, is still another of those near-modern works which exists in more than one format, and is highly "interpretable"—depending on which elements the conductor feels like bringing to the fore. In one sense, it is the ultimate and final Romantic piece, straight out of Tristan. In another it is the beginning of Schoenberg atonality (that, too, out of Wagner). It is super-passionate—but can be toned up, or toned down, to taste. Here are two reissue versions by two superb older conductors, totally unlike.

It is good to find Mitropoulos reappearing. He was one of the great ones, though too belatedly recognized and not very popular when he was in New York. (He modernized a bit too fast for local tastes.) But his Schoenberg is of the old school, all shrieks and sobs, carried to the ultimate passion. This is the way I always used to know it—and hate it. (I detested passionate music as a youngster; I was all for neo-classical restraint.) One vital point that makes me love this version now—*it is in tune*. The Schoenbergian Wagner-type harmonies change so fast that many orchestral string players simply do not hear what is happening, especially in the very high-pitched passages, hard enough to hit accurately in any case. So they sob excruciatingly out of tune. Not so here. Mitropoulos knew what he was doing. Good man.

As for that unpredictable old sob-expert, Stokowski, he is all modern restraint in his version. The piece (like Bartók's Music for Strings, Percussion, and Celesta) was originally "chamber music," one instrument to a part, but was re-arranged by Schoenberg for string orchestra with some passages still played on solo instruments. Where Mitropoulos plays these down — you hardly notice them—Stokowsky plays them up and tones down the big climaxes to such an amazing degree that one hears almost a new piece, semi-chamber-like and not at all over-passionate. Very interesting.

The Mitropoulos "stereo" derives from Columbia's ML 6007, which would be one of the very earliest LP releases, not even taped, back in 1948. The stereo is, thus, simulated, even if it doesn't say so. Somewhat grainy sound by present standards but not bad, considering those screetching strings. Don't know where Angel got hold of Stoky "& His Orchestra," but the recording seems fairly new and in true stereo.

You can have the two accompanying works. Loeffler's Boston-bred Pagan Poem, of the early part of the century, is a big, turgid piece of American impressionism with some famous trumpet passages, including a walk-on trio of them at the end—this is not a convincing version of the music. As for the Tallis Fantasy, it always has seemed to me a lugubrious and utterly dated elaboration of poor Tallis's original; Tallis is very good on his own, thank you. Good friend of mine, even if he did die in 1585.

Performances: B+ *Sound:* B

Milhaud: Six Little Symphonies; L'Homme et son Désir. Soloists, Orch. of Radio Luxembourg, Milhaud. **Vox Candide CE 31008 stereo** ($3.50)

Symphonies? With Milhaud, be ever prepared for surprises. Part of the "French Revolution" of the period after WW I was a conscious slapping-in-the-face for every basic tenet of the older, more genteel music. Since the Symphony was the 19th century's ultimate form, Milhaud, you can guess, must slap it down. These are tiny little morcels, only a few moments long and deliberately of an inconsequential effect—though there is much Art concealed in their varying, etude-like instrumentations. They are also, of course, tinny, squeaky, saucily dissonant and often inelegant — that was part of the deal. Accept all this, and you'll enjoy the whole business. Milhaud was a good craftsman. Still is.

"L'Homme et son désir" was a 1921 ballet, in the days when ballet was the biggest source of shock in the new Revolution. No use going into the outrageousnesses of the actual performance—that had people foaming at the mouth. (Was this the one where the audience arrived for the premiere, to find the cast had taken off for a vacation? Big joke.) What you will hear in the audible music is a lot of wordless singing (same effect appears among the Symphonies), lots of innocuous little folksy melodies and much thumping and bumping of percussion plus a good deal of the then-new jazzy sort of rhythm. No great shakes, and pleasant home listening today. Maybe it's as well we are spared the actual production!

Performances: B *Sound:* B+

Prokofieff: Symphony No. 2; Lieutenant Kije Suite. D. Clatworthy, bar., Boston Symphony, Leinsdorf. **RCA Victor LSC 3061 stereo** ($5.95)

Prokofieff: Symphony No. 2; Symphony No. 7. USSR State Radio Symphony, State Philharmonic Orchs., Rozhdestvensky. **Everest 3214 (sim.) stereo** ($4.98)

Two choices here for the loudest, brassiest, most dissonant of Prokofieff's symphonies, the No. 2, a work straight out of the depths of the 1920s and heretofore tactfully ignored—for it is an earful! But today, we are beginning to enjoy this kind of earful. It is so very "modern," and so very dated. Rather nice to hear all that old fashioned cacophony, especially in stereo hi fi. The two discs offer contrasting material to accompany No. 2. Everest has the last of the symphonies, No. 7 of 1952, a sweet, ingratiating, nostalgic piece and the last work the invalid composer managed to complete. From Boston, on RCA Victor, we get the familiar Lieutenant Kije, the man who never was, his little trumpet tune hopping unexpectedly from key to key—but here with a difference. Two items in the original film score were sung by a baritone; here these two revert to the original format, for a change. (I prefer the instrumental version, thanks.)

RCA's Symphony No. 2 is a big, fat, shiny production, massively recorded, as befits the august BSO. Good performance. Everest's, via the USSR Radio Symphony (assuming they haven't reversed their labeling—see below) is even a little better, a drier sound and a tighter playing to emphasize the 1920s seriousness of all this dissonance, an effort by the young Prokofieff to show that he could be as modern as anybody at the time. This is a true stereo recording if I hear it rightly, and a good one of its dry sort.

Everest's No. 7, on the reverse side, has the same conductor, but the *other* orchestra—whichever one it may be. It is well enough played, though I have heard more persuasive versions, even

including Ormandy's on Columbia. But the recording on this side is another story. As you flip, the sound deteriorates; this is out of a wholly different set-up, even with the same conductor. Moreover (says my ear), this appears to be a simulated stereo, out of a mono original, even if it doesn't say so. And those vague stirrings in the background—are they a "live" audience? Is this from a broadcast? Could be, even if, supposedly, the other side is the "Radio" orchestra. (The ascriptions are casually reversed, you'll note, as they appear on the backside of the jacket.) So who knows? The conductor does. He conducted both. Go ask him, if you want to know.

Just to confuse the issue, I note that Angel also offers the same Symphony No. 7 with the very same conductor, on its Melodiya label! There, the orchestra is listed as the *Moscow* Radio Symphony. And the recording on that one is in full stereo.

One thing is definite. It'll cost you more to hear No. 7 conducted by Rozhdestvensky via Melodiya, the official USSR recording outfit.

Performances: A, A+ *Sound:* A, B—

I Musici Play Works by Martin, Hindemith, Roussel, Nielsen. Philips PHS 900-198 stereo ($5.98)

Though it isn't exactly mood-music in effect, the sound of this superbly skillful Italian string group remains one of the sensations of today's music listening. Once hailed by no less a Maestro than Toscanini, I Musici were one of the first of the new-style virtuoso groups of a dozen or less players, smaller than an "orchestra," larger than a chamber ensemble, and ideal for recording (though I Musici was primarily a concert organization). I Musici's precision is now fantastic. The recorded sound by Philips is a model of stereo string portrayal. Normally, I Musici has played older music, often of the Baroque period and largely out of Italy. Here they go modern, if conservative-modern.

The most imposing and longest work is by the Swiss Frank Martin, now in his late seventies. His Etudes for String Orchestra though composed in 1956 are in the manner of the Thirties, neoclassic, with skillful suggestions of earlier Stravinsky, Hindemith, even an almost-quote straight out of Bartók (a pizzicato scherzo). It is superbly written for strings and sounds out most impressively, but for my ear it is too long for its various messages, and more professional than original. Good listening just the same. The earlier Roussel is in a similar vain, out of 1934, also very expert and rather glibly complex. Nielsen, the Great Dane who is now having a Revival, wrote his little Opus 1 Suite, played here, back in 1888. For its time it must have been strikingly modern; to our ears it is a bit amateurish, diluted Grieg, not at all pretentious (which is in its favor) and merely too long. What Opus 1 isn't too long?

Only the Hindemith *Trauermusik* (Mourning Music), a short piece written on the death of King George V in 1936, comes a real cropper here. Just doesn't make sense — and it's a good piece. The Italians sadly miss its entire strengths, the very Germanic "dotted" slow-movement rhythms, the pointed dissonances, the passionate Teutonic dignity. A fine viola soloist, even so.

Performances: A— to C+ *Sound:* B+

Specialties

Beverly Sills. Bellini and Donizetti Heroines. Vienna Volksopern Orch, Akademie Chorus, Jussi Jalas. **Westminster WST 17143 stereo** ($4.79)

All coloratura sopranos emulate the proverbial canary—but as time marches on, their song-style changes. And, also, it depends on what country you're from. Beverly Sills comes from the Boston region, as of today, but she travels, as can be noted from the above. She has been a recent sensation in New York opera; she is one of those singers who mass-produce the world over with no trouble at all. She mass-produces here, faultlessly.

No—her exploits do *not* hark back to the great days of the golden age, however brilliant. Her sound is strictly of today, and out of the U.S. at that, and not in the slightest like the famed European coloratura voices of recent memory, nor those of a half century ago. She has the characteristic strong vibrato of our time, the complicated yet white-sounding tone color (the earlier singers produced a thinner, more brilliant tone almost without vibrato) the somewhat indifferent "scale," that smooth progression of color from low to high notes that once was the special pride of a good singer, the somewhat breathy production, all of which mark the current product of the singing teacher's art. Typical, if Grade A in current terms.

What will interest the general music listener here is not so much the Sills vocal fireworks as the curious period sound of these numerous excerpts from the two Italians of the first part of the 19th century, Bellini and Donizetti. It is a sort of double-feminine Rossini, a Mozart style gone all sugar, a gentle yet remarkably artificial kind of singing, quantities of the sheerest vocal ornament crusted onto the thinnest of fragile harmonic foundations . . . it was from this that the Wagnerian heavyweight reforms took off!

Sills produces the fireworks with aplomb and ease; you get the feeling she could do it all night with one eye opened. But it really isn't very exciting. No tension in it. There isn't much in the music itself for her to work on. (Yet some of the old gals, around 1900, could make your hair stand on end in this sort of music. A different singing league.)

Performance: B+ *Sound:* B

National Anthems of the World. Vienna State Opera Orchestra. **Everest 3239 stereo** ($4.98)

The assembled flags of the United Nations make a colorful display, as per the cover of this record; the collected anthems are something else again.

Everest's "orchestra" is in fact a ponderous brass band of the tubby, thumpy sort, and nary a string to be heard. Nineteen ponderous anthems, one right after the other, and each solemnly introduced by an official drum roll (gotta maintain the diplomatic niceties) — except, inexplicably, Israel and Japan. Each one played with all the pomp and circumstance that national pride presumably requires. And all nineteen, in this case, done up with a wholly Austrian weightiness — even unto the Star Spangled Banner, which is full of wrong notes.

It's like a nineteen-course state banquet, every course a fat hard-boiled egg.

There are a few amusing side notes. Israel's anthem seems to be the English tune "I had a little nut tree, nothing would it bear" put into a minor key. "God Save the Queen" sounds, as always, like "My Country 'tis of Thee," which in fact it is. The Swiss anthem "Rufst du mein Vaterland" sounds like "My Country 'tis of Thee," which it also is. Whatever happens when the Switish and the Brish get together?

Performance: Heavyweight *Sound:* B

The Missing —

Check No. 58 on Reader Service Card

Jazz

BERTRAM STANLEIGH

Jelly Roll Morton

EACH TIME RCA Victor brings out a new collection of Jelly Roll Morton reissues, I am bowled over once more by the enormity of Morton's genius, as well as the skill and sensitivity of the Victor engineers in handling these transfers. It has been 28 years since Morton left us, but thanks to the creative and responsible use of its archives, RCA has kept the recorded legacy of this artist available to the public. And it has done so with scrupulous concern for extracting all of the music from the old 78 grooves while leaving out the bulk of objectionable hissing, ticking, and popping.

For this, the fourth in its Vintage series of Morton reissues, producer Mike Lipskin has selected nine numbers from Morton's last two sessions for Victor in 1939. On the first of those two occasions, Morton had selected a band consisting of Sidney de Paris, trumpet; Claude Jones, trombone; Sidney Bechet, soprano sax; Albert Nicholas, clarinet; Happy Cauldwell, tenor sax; Lawrence Lucie, guitar; Wellman Braud, bass; and Zutty Singleton, drums. The second session had much the same line-up, except that Bechet did not participate, and Fred Robinson replaced Jones on trombone. Morton had a special ability for selecting both exceptionally able performers and men who could adapt their styles to his requirements. No matter who played on a Morton session, the music that resulted had that special swagger that was a Morton hallmark, and there was always an excitement and immediacy both in the playing of Morton and in that of his collaborators.

Of particular interest are the recordings of "High Society," with Bechet and Nicholas competing in the famous solo spot; "Oh, Didn't

He Ramble," the traditional number for New Orleans bands on their way back to town following a funeral; and Morton's nostalgic vocal on his own "I Thought I Heard Buddy Bolden Say." In addition to the 1939-session recordings, this new reissue contains some of the trios that Morton waxed in 1929 with Barney Bigard, clarinet, and Zutty Singleton, drums: Morton's "King Porter Stomp"; a piano solo taken from one of the Chamber Music Society of Lower Basin Street's NBC broadcasts in 1940; and a recording of Morton at the piano in a waxing of "New Crawley Blues" by Wilton Crawley and the Washboard Rhythm Kings.

Of course, these performances don't sound like the very best of the new recordings, but it is absolutely amazing how good they do sound, and that sound is enhanced by the excitement that runs through these great performances. Once one adjusts one's listening attitude to the initial sound quality, there is little, if any, awareness that one isn't listening to fresh, new recordings.

Jelly Roll Morton: I Thought I Heard Buddy Bolden Say
RCA Victor Mono LPV-559

Performance: A+ *Sound:* A—

Urbie Green: 21 Trombones, Rock, Blues, Jazz, Vol. 2
Project 3 Stereo PR 5024SD

Enoch Light's ability to come up with new sonic surprises has earned him a special position in the ranks of record impresarios. Probably one of his most unusual innovations was bringing together 21 of the country's finest slide-horn virtuosos. Headed by Urbie Green, a young veteran who seems equal to the most rigorous demands, and backed by a batch of colorful rhythm and percussion effects, these trombonists stood the public on its collective ear in their first set of pop numbers. The success of that first platter has resulted in a second, even finer effort. We still have the rare, dark brooding sound of all those trombones, but now we also have some music that makes the group catch fire. Be sure to catch their waxings of *Perdido, I Got a Right to Sing the Blues,* and their adaptation of *Flight of the Bumble Bee.*

Performance: B+ *Sound:* A+

Light Listening

SHERWOOD L. WEINGARTEN

A Thrush for All Seasons

A husky quasi-whisper sneaks from the speakers, smoothly changes to a semi-boisterous trill, then switches to a gossamer warble. Barbra Streisand, right? Wrong!

Well, half-wrong. It's Roslyn Kind, Barbra's half-sister, who has parlayed the partial kinship and a total talent into a winning ticket to instant stardom. The younger thrush, a barely-18 hazel-eyed brunette, seems to have everything Funny Girl has—with the exception of the need for a nose job, and the addition of an appeal to the Shaggy Set.

GIVE ME YOU (RCA Victor, LSP-4138), her initial recording, quickly shows by its range that the singer seeks no narrow bag into which she can artistically crawl. "It Was Only a Dream," for instance, is sung in a glossy soul style, supported by an easy Latin beat and a chorus. "I Own the World," though, is a Broadway-type Streisand presentation without Roslyn resorting to the Ethel Merman-like bellowing Barbra occasionally enjoys.. And "A Modern Version of Love," a tricky melodic composition, delves into country music midway (and is somewhat marred in the process). "The Shape of Things to Come," the only track of the 11 aimed directly at electronics-crazed youngsters, finds Roslyn slipping into Judy Collins contemporary art garb, while "Summer Tree" offers extra Kind-ness as the vocalist harmonizes with herself via overdubbing.

Not unlike Barbra, Roslyn seduces a song, squeezing the meaning from lyrics, caressing the nuances, insisting the melody be branded by the white heat of her intensity. Vocal phrasing of the sisters is similar, especially on ballads such as "Who Am I?" and the title tune. A nonsuspecting listener would mistake one for the other. Yet when the tempo builds, and the pop emphasis is introduced by arranger-conductor Lee Holdridge, the differences are as distinct as the stereo separation on

". . . Dream." Only two cuts fail: "Can I Stop the Rain" is over-orchestrated and ends as if no one were sure any grooves were left; "If You Must Leave My Life," a Jim Webb composition, is merely bland.

Roslyn Kind, whose enunciation equals that of Lena Horne, created a mild sensation on a recent Ed Sullivan videoptic extravaganza. She was rapidly signed for a reprise. Clearly, the teenager's star is rising like a Saturn booster. She deserves it, for she offers a Voice, not an echo.

* * *

If singer Mel Torme is the Velvet Fog, troubadour Rod McKuen is the Burlap Mist. McKuen, whose pen usually intertwines a love of nature and a zest for life, somehow managed the improbable—being both a best-selling poet and an anti-hero for the Don't-Trust-Anyone-Over-30 crowd. But now the minstrel, approaching 40, is trying the impossible—aiming his sandpaper-textured tonsils toward those who prefer Lawrence Welk over Lawrence Ferlinghetti.

BITS AND PIECES (Decca, DL-75078) is likely to satisfy no one. Youngsters will dislike the dilution of the folk-oriented melodies; oldsters will object to the hodge-podge character of the LP, and to a non-singer vocalizing; sound addicts will shun the almost stereo-less stereo; McKuen buffs will fume because he renders only two of his own compositions. "Hi-Lili, Hi-Lo" seems to be the only track that is totally pleasing to the ear, perhaps because of the breezy woodwind riffs that give it color.

* * *

Spurred by Mideast tensions, manufacturers have pressed Israeli groups and songs. The unfortunate result is an avalanche of mediocrity. One exception is JEWISH RHAPSODIES FOR THOSE IN LOVE (Bravo, B-35502),

a disc arranged by Pete King for an anonymous studio ensemble called the Israeli Strings.

The dozen melodies by the aggregation offer half an hour of relaxed, cotton-candy listening for audiophiles who choose to pay attention; for those who prefer Muzak mellowness, orchestration easily can be subordinated by conversation; for those with an insatiable thirst for good sound, enjoyment will be ensured by a graceful separation that avoids the gimmicky ping-pong effect. The strings, naturally, carry most of the burden. But woodwinds—particularly flute and oboe—and piano solo often contribute heavily.

The package dips into Broadway for "Sunrise, Sunset" (from "Fiddler on the Roof") and "Milk and Honey." It borrows from Hollywood ("The Exodus Song") and Tin Pan Alley ("Bei Mir Bist Du Schön"). And it leans on Al Jolson, for "Anniversary Song," and tradition, for "My Yiddishe Momme."

For the most part, the LP is a winner in the softness sweepstakes. Only "Milk and Honey" gets at all bouncy.

* * *

Jackie Gleason has become an American mirror image of Mantovani, turnout one velvety LP after another. THE BEST OF JACKIE GLEASON, Vol. 2 (Capitol, SKAO-146) is the latest compendium of romantic sweets from the triple-threat man (humor, music, and booze, in any order you choose).

Bobby Hackett's trumpet and Tony Mottola's guitar are the real diamonds of the lush orchestra, although Gleason made sure to flavor his melodies with an occasional touch of artistry from oboe, trombone, flute, and piano. Best tunes are "My Funny Valentine," "I Got It Bad and That Ain't Good" and "It Had to Be You."

* * *

The trouble with William Basie is that he reached the top and had nowhere to go. HOW ABOUT THIS (Paramount, PAS-500001) contains a glossy, ultra-commercial mixture totally lacking in innovations. The Count, in a half-jazz/half-pop bag, is stuck in a groove instead of being groovy.

Even the addition of Kay Starr's vocals (the two stars are paired for the first time) don't help, for she never seems quite sure whether she's a blues singer or someone trying to hit high C-note on the cash register. She also errs in trying to re-interpret songs too well associated with others (such as Billie Holliday's "God Bless the Child"). *Æ*

CLASSIFIED

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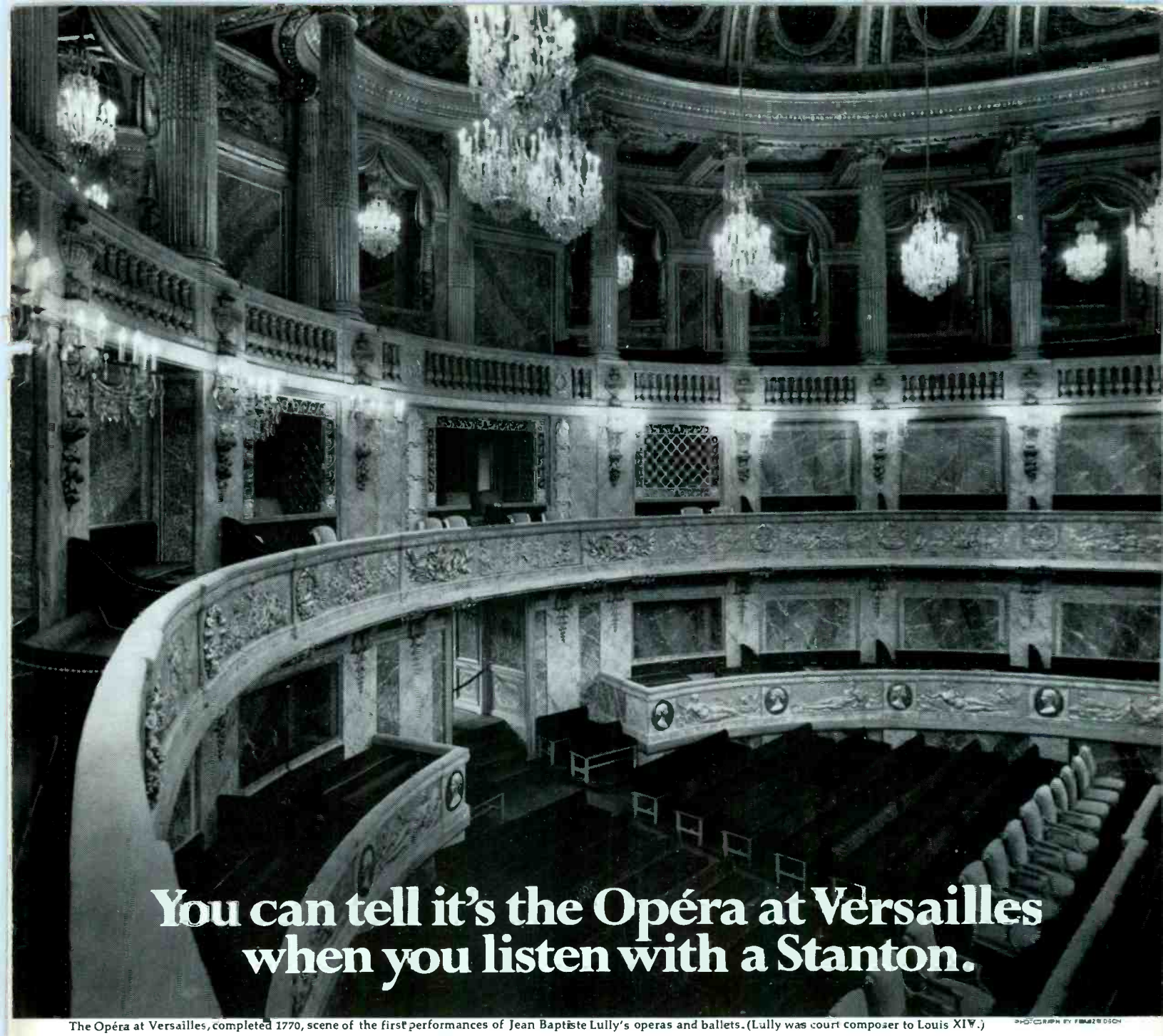

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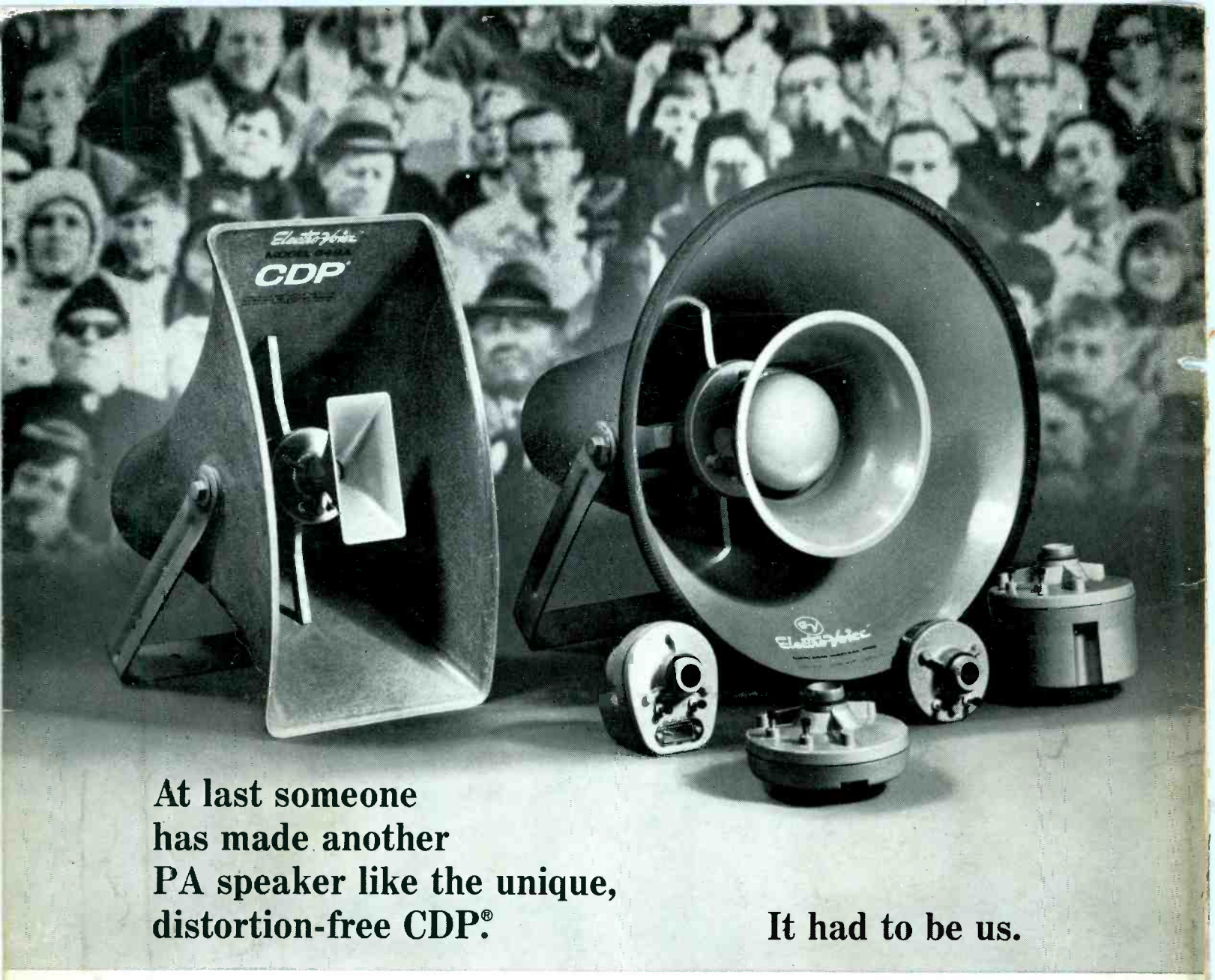

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