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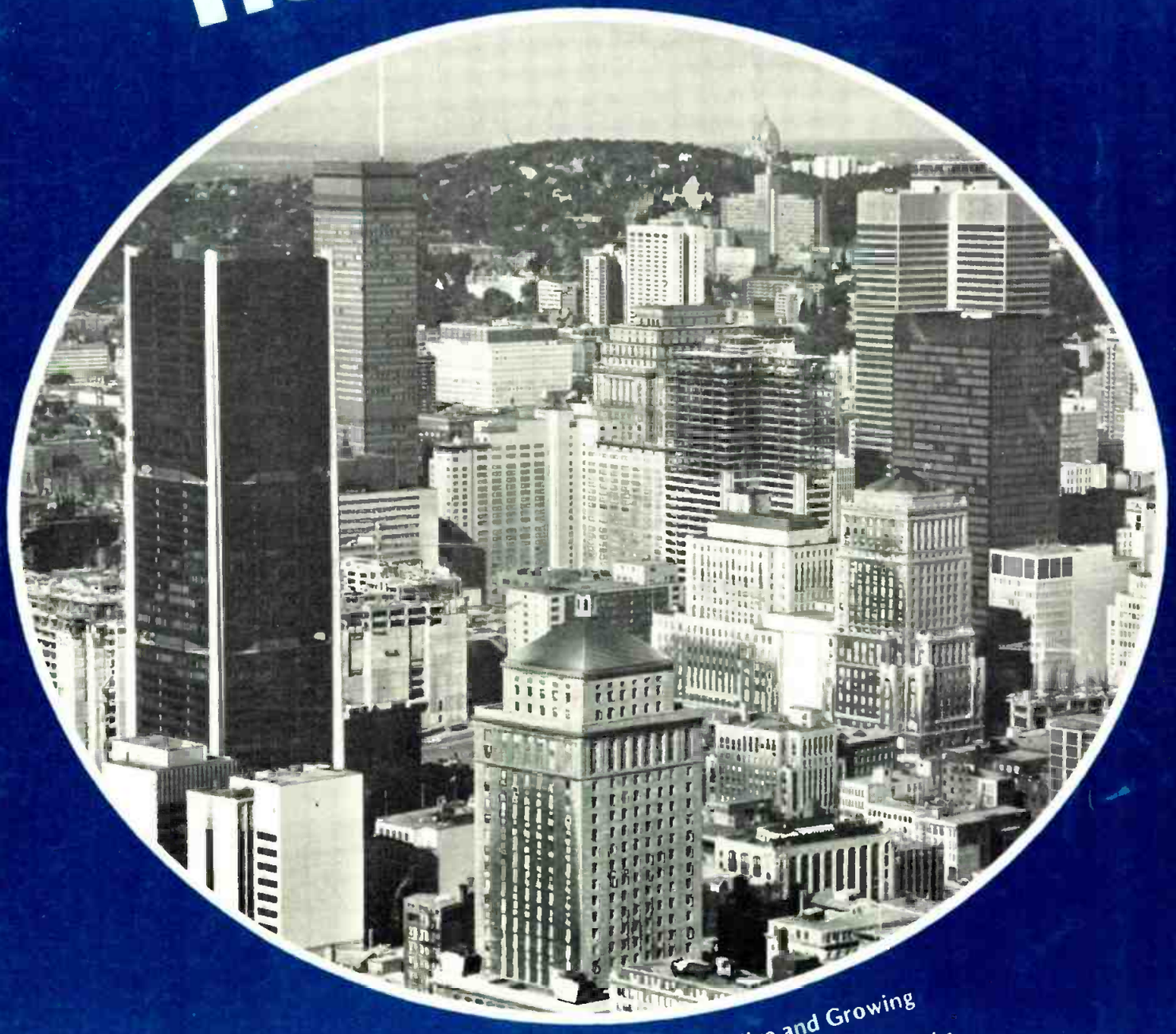
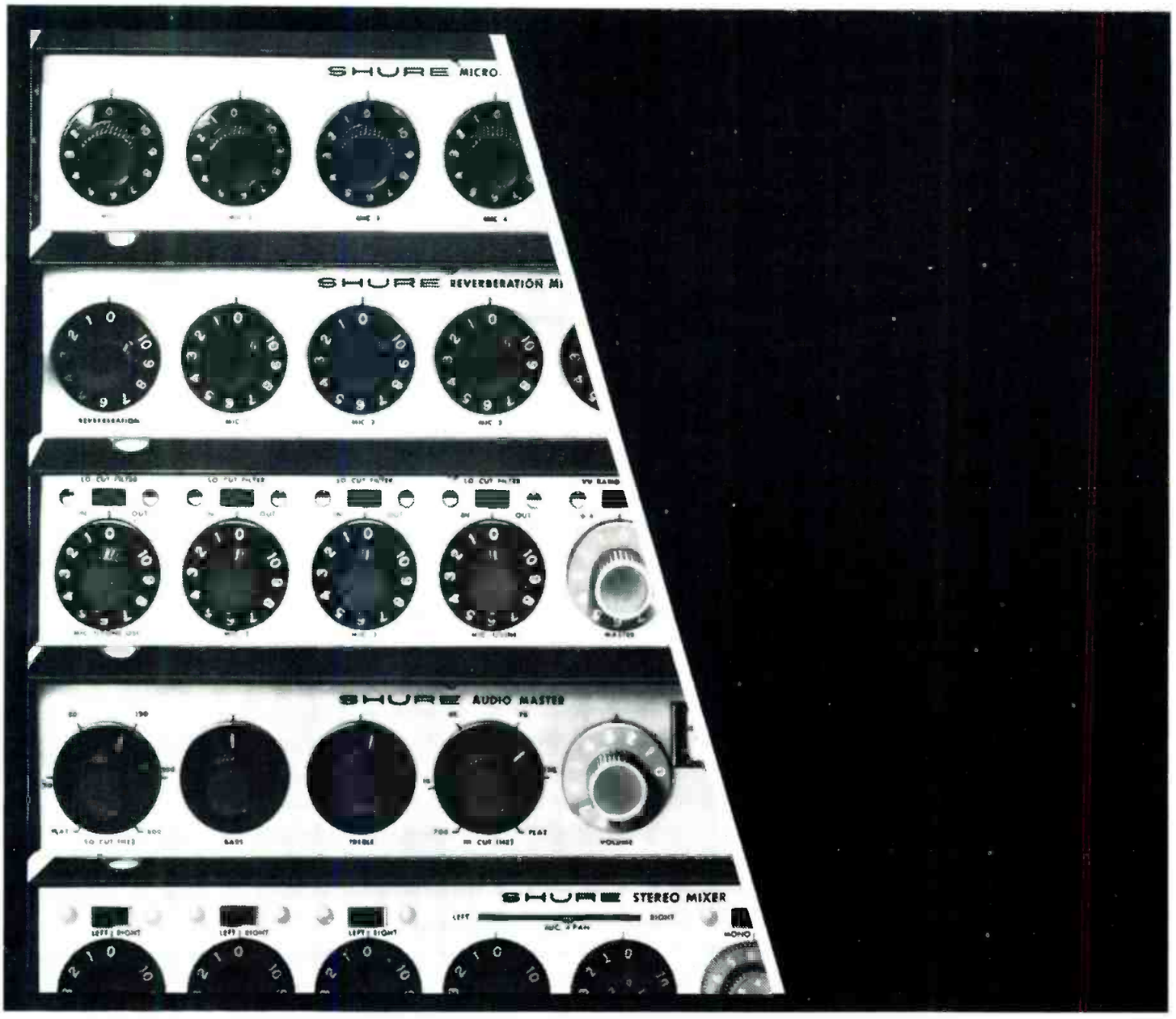
MARCH 1975 $1.00

SPOTLIGHT ON MONTREAL



IN THIS ISSUE:

- Audio in Montreal Alive and Growing
- Versatile Low-Level Crossover Networks
- Solid State Switching for Audio



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COMING NEXT MONTH

● Sidney Silver discusses methods of speeding up or slowing down speech reproduction without significant distortion or loss of intelligibility in COMPRESSION AND EXPANSION OF SPEECH IN TIME.

● The loudspeaker can introduce greater reproduction errors than other audio system components. C. R. Heft, Canadian Broadcasting Corp., tells how to test monitors for realistic sound reproduction in WAYS TO EVALUATE MONITORING LOUDSPEAKERS.

● In RECORDING STUDIO ACOUSTICS, PART 5, Michael Rettinger explains why a newly completed studio must be tested for noise, echoes and sound foci, reverberation, cell isolation, and loudspeaker and transfer response.

ABOUT THE COVER

● This attractive aerial view shows downtown Montreal, Quebec, and was supplied to us by the Information Office of the Canadian Consulate General.

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MARCH 1975, VOLUME 9, NUMBER 3

db is listed in **Current Contents: Engineering and Technology**

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CALENDAR

APRIL

3, 4, 5 Institute of High Fidelity, San Francisco Civic Center, San Francisco. **Music Week** theme. Setup time, April 1 & 2. Contact: Dick Ekstract, Chairman, Show Committee, Institute of High Fidelity, Inc. 516 Fifth Ave., New York, N.Y. 10036. (212) 682-5131.

2-8 National Federation of Electronic Industries and the Components Union . . . **18th International Electronic Components Show**, Parc des Expositions, Porte de Versailles, Paris, France. Contact: French Trade Shows, 1350 Avenue of the Americas, New York, N.Y. 10019. (212) 582-4960.

5 **Midwest Acoustics Conference**, Northwestern University, Evanston, Illinois.

6-9 **National Association of Broadcasters Convention**, Las Vegas Convention Center, Las Vegas, Nevada.

8-11 **Meeting of the Acoustical Society of America**, Conference Center, Austin, Texas.

21-23 **ASTM Committee E-33 on Environmental Accoustics**, St. Charles, Ill. Contact: Mr. Chas. W. Rodman, secretary, Battelle Memorial Institute, 505 King Ave., Columbus, Ohio 43201. (614) 299-3151.

23-27 **Sonex Europe** '75. London, England.

MAY

Early May Two-day **Workshop on Children's Television**, National Association of Broadcasters, Washington,D.C. Contact: Mr. Robert D. Gordon, N.A.B., 1771 N St., N.W., Washington, D.C. 20036.

6-8 **NEWCOM Electronic Industry Show** '75. Las Vegas Convention Center, Las Vegas, Nevada.

13-16 **London International Electronic Component Show**. London, England.

13-16 **Audio Engineering Society, 51st Convention**, Los Angeles Hilton, Los Angeles, Ca.

JUNE

9-27 **Brigham Young University Audio Recording Technology Course. Contact:** Russel Peterson, Audio Recording Technology Course. 242 Herald R. Clark Bldg., Brigham Young University, Provo, Utah 84602. (801) 374-1211, ext. 3784.

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Ampex	BLM200	Yes	240 master 60/120 slave	50-10,000 Hz ±2db	Yes	Yes	$51,695
Electrosound	6000 8LF	Yes	240 master 60/120 slave	40-12,000 Hz ±2db	Yes	Yes	$69,730
Otari	DP-6000	No	240 master 60/120 slave	30-10,000 Hz ±3db	Yes	Yes	$57,100

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db theory&practice

NORMAN H. CROWHURST

● It had to happen, sooner or later. Nobody is perfect. Ever since this column started, from time to time, we have received letters from readers, telling where Mr. Crowhurst went wrong. Till now, none of them has been right. However, when anyone misunderstands what I have written, to *think* it is wrong, I always feel that maybe I did not say it plainly enough in the first place, and thus they were right to criticize, although their actual correction was wrong.

So, in my November column, I eventually goofed, fair and square. And thanks are to Louis Abbagnaro of CBS Labs, among others, for drawing it to my attention. After correctly stating the difference between white noise and pink noise, to illustrate, I said that there is more energy in the hundred cycles from 10,000 Hz to 10,100 Hz than there is in the hundred cycles from 1000 Hz to 1100 Hz —white noise, that is.

As I knew well enough, that is not true. Somehow, what I wanted to say got crossed up. It can happen to any of us, I have always known that. As Louis Abbagnaro pointed out to me, any 100 cycle bandwidth contains the same amount of energy, if it is white noise. What I should have said was that the octave from 10,000 to 20,000 Hz contains 10 times the energy, of white noise, as does the octave from 1000 to 2000 Hz. With pink noise, each octave band would contain the same amount of energy. I said that part correctly, but somehow managed to goof, in putting together the statement about white noise that went before it.

LEARNING FROM MISTAKES

In that case, I knew better and I suppose the only thing I can learn from that is to be more careful, always to double check what I say, to be sure that I've said what I thought I said! But as we've started to talk about mistakes, let us pursue that a bit. It can have both educational and technical implications.

When I teach in the classroom, I have always found that an effective way to keep the students interested is to throw in a deliberate mistake. What will they do? A lot of students will never notice it, because they are accustomed to teachers who don't make mistakes. Even if they are wrong, such teachers will never admit it! So if students think they spot a mistake, they will often keep quiet about it.

Having put a deliberate mistake on the board, if nobody spots it, I will usually ask if someone sees anything wrong. After that, I will tell them that I occasionally do that and that sometimes it is not deliberate, because I too am fallible! Most teachers would be afraid to say something like that, as if they were falling off their pedestal, to admit that they even could make a mistake! But I find that students respect me much more for that, and that I gain immediate rapport.

But mistakes are also a valuable learning tool. Since all of us make mistakes—it is wisely said that the man who never made a mistake never made anything—we need to have ways to find our own mistakes before someone else does. If I'd been following that advice when I submitted the column that was published in November, Louis would never have had occasion to write to me!

In my problem solving arts course, in particular, very few lessons go by without using this technique in one way or another. How can you be sure your answer is correct, without going to the answer book, or asking teacher? In electronics, if you put in a wrong resistance value, because your calculations were wrong, maybe you'll blow a transistor. Not too bad a consequence, perhaps, but you'd better check your working before you blow another one.

But we wonder how many of the bridges that have failed in recent years did so because some engineer slipped a decimal point in his calculations and had no way to check his results.

That can be far more costly, even in lives, in some instances. What a pity those engineers did not learn how to find their own mistakes!

MICROPHONE PLACEMENT

Enough about education, or I may be in trouble for straying from the subject this magazine is supposed to be about. My colleague, John Woram, has been doing a good job on questions relating to miking various instruments and instrumental groups, so I will not confuse you by trying to add to what he has been doing very well. Rather, this will recount a recent instance that illustrates a mistake that John has talked about quite a bit.

As John has pointed out very well, there are no universal answers about how you mike this or that. And as I have said before, my son Nigel is becoming quite a musician. Presently in his junior year at high school, he has been invited to play with the college stage band once or twice, over at Oregon College of Education. It was in the latter context that the example I want to relate occurred.

A little earlier this year, they had a stage band festival, with about a score of high school bands from around the state, the college band, and the navy band thrown in for good measure. This was held in the college gymnasium, a fairly old building that has been acoustically treated very well. It has a cylindrical roof, and windowless walls, all of which have been treated with genuine acoustic tile. As a result, the gym is probably as dead as I've heard any gym of comparable size. Most gyms of that size would be impossible for music, because of the excessive reverberation.

They had mics in the band, for cross-feeding the players, so they could hear one another. But for general pickup, they had only two mics, placed some distance away, high in the air, which they recorded in stereo. Because of the acceptable deadness of the gym, the results were quite good: a stereo recording of a live performance, with audience sounds and all.

A little later in the year, they went back into the music auditorium they usually use for concerts for a jazz concert by the college stage band. This auditorium has a lower ceiling, about 16 feet above the floor, covered with imitation acoustic tile, whose absorbency is poorer than the genuine, but older material, in the gym. This was probably selected because of a cost factor. But to musicians, acoustic tiles are acoustic tiles, aren't they?

A bigger difference was in the walls, one of which is solid plate glass along the whole side, from floor to ceiling. The other is a normal plaster wall, with some interruptions. The back is a plaster wall painted black, which conveys an optical sense of absorption without a corresponding acoustic absorbency. The room, as you can imagine, although smaller in cubic volume than the gym, is considerably more "live." More important, its reflections are quite definite "lumps"—each wall being a pretty good reflector.

In fact, I was sitting about one third of the way from the glass wall and I could hear a very definite mirror image of the whole band, coming off that glass. They had placed the mics very similarly to the positioning that had proved effective in the gym. Why wouldn't that work here too?

Of course, it did work, but the recording was disappointing. I don't know what they used in the gym, but they used omni mics in this auditorium. You don't need me to spell out why the sound seemed confused, when they played back their stereo recording.

LOOK WITH YOUR EARS

That is a classic sort of mistake.

Same band, same kind of program material, but a totally different kind of auditorium. Pursuing what John Woram has been saying, how do you lay down the kind of rules his readers want, on how to mike such a situation? In a sense, there is no substitute for experience—quite a lot of it. But we can help experience to be more meaningful by pointing out the factors of which the person who does this kind of work must be aware.

When you enter such a situation, you need to "look with your ears." What clued me, immediately, was my consciousness of the sound bouncing off that glass wall. I could not see the wall because it was after dark and the thin black draperies were drawn. But the absorbence factor of those draperies was close to zero and my ears told me the glass was there, even if I had not known that from having been in the room in daylight hours.

Omni mics, placed that far from the band, would each pick up everything they "heard." Our human hearing can discriminate, directionally, but omni mics cannot. Having said that, I'd better clarify myself. Human hearing does not have the characteristics of a cardioid mic, or any other directional mic. Our directional capability is not built into our ears, as a mic's capability is built into it. But directional mics can be used to discriminate, which omni mics cannot.

Possibly, just substituting cardioids for the omnis they actually used, would have improved the situation we just described. But when cardioids are used another improvement can be made. This is to put the mics together, and closer to the band. If you put omnis together like that, they would both "hear" the same and there would be no stereo. But when you place cardioids together like that, one points to the left side of the band and the other to the right.

The important benefit from using cardioids and putting them together in this way is that time difference between the two channels, left and right, for the direct sound coming from the band, is minimized, reduced to virtually zero. Thus all the echoes, as well as being reduced in pickup level because they come from the sides of both mics, have a longer delay than the direct sound, and thus are more definitely distinguished as being of reverberant origin.

It pulls the band together and gives it a crisp integrity, where each instrument comes in true, while the other way produces multiple images all over the place.

In this, we have discussed only possible ways to make 2-channel stereo, using no more than two microphones, of appropriate type, because that was what the people on the job were concerned with doing. I do not suggest that the ways I have just described are the best way to mike either job, if you had unlimited facilities. But part of being a good professional is being able to do the best with what you have, even when that isn't as much as you might like to have.

I remember, when I was a boy, listening to a high class organist who visited us, play on our old harmonium. Many an organist would not demean himself to play on such an instrument. But this man played it, and somehow the sound from that instrument, almost by magic, sounded more like a big theater organ than I had ever heard it before. He was, without doubt, a truly professional organist. Even our little old harmonium sounded better when he played it.

Just so, if you are a true professional, you will not say, "I can't do anything with . . ." whatever it is you have at the moment. You will do the best possible with it, and perhaps your listeners will be surprised at how good it is. ■

db sound with images

MARTIN DICKSTEIN

• Through the many issues in which we discussed 16mm film projectors, the different types, some of the newer models, and comments by readers, we also mentioned some of the tips which would help keep the units clean and in satisfactory working condition. We talked about autoload and manual threading units and passed along suggestions on keeping the projectors, and the film path clean. Let's just add a few items about handling the film, and trying to extend the image life of the motion picture.

One recommendation we have always found useful for several reasons has been to put a long leader on the head end of the film. For example, if the previous user of a self-threader model rewound the film through the film path, he could have overlooked the possibility that the adhesive tape he used to hold the head of the film to the take-up reel might have gotten stuck in the gate. This goes unnoticed and unchecked, and then the next user finds that the film does not go through the projector but starts to back up, and the film begins to fold, rip and crease beyond repair. Several ways to avoid a similar situation can come quickly to mind. One possibility is to avoid using the sticky tape at the head end. If it must be used, opening the gate might prevent the tape from sticking on the way through. Another way to avoid trouble is to stop the film just before it enters the gate and remove the tape. Should all else fail, if there is a long leader on a film used in a self-threading machine, at least the leader will wrap up and leave the film intact. Hopefully, the operator will be watching when the mess-up starts and will stop the machine before the film is shredded completely, but long leader will still save the film for a while if he forgets where the stop switch is.

THREADING MANUAL LOADING

Another problem that comes up quite often is in threading a manual-loading machine. When the film is put onto the sprockets, it sometimes happens that the film sprocket holes don't lie evenly on the sprockets. If not checked, the film can slip out, the holes can tear, the film can be scratched, and can even be ripped badly. Not only should the film be loaded carefully, but when the film can be run ahead manually by the simple expedience of turning a knob, this method should be used to make sure that the sprockets fit cleanly into the holes and that the film will move smoothly. A similar problem can come up when the film is put around the sound drum too tightly and pulled too hard through the paired tension idlers on either side of the drum. A slight tear in the sprocket holes can cause the film to tear when it gets started and to fail to pull smoothly. Once again, if a long leader is used, at least the film portion can be kept in good shape while the trouble takes place during the leader.

One more trick to preserve the life of the film is to be carefully aware of the condition of the film reels, both the feed and the take-up. A bent or dented reel, or nick in the edge can be disastrous. As the film rolls onto or off the reel, the edge of the film can tear, not enough to be noticed the first time, perhaps, but it will show up in subsequent plays and the film can be badly ripped by such a small thing as a torn sprocket hole.

SPLICES

Several more possible trouble spots are at splices. A cement splice, as simple as it may seem, should be made with care. If the film is not scraped carefully, the bond will not hold over the width of the film, and a slight edge sticking up will most likely open during the first play through the projector. If too much cement is used in the splice, excess is likely to spread out around the splice and catch on adjacent layers of film during winding, causing a smear, and possibly injuring the magnetic sound track. Too much cement can also cause the film to buckle slightly, leaving open the possibility of a torn film during the run through the projector.

If too little cement is used in making the splice, obviously the splice may not hold and the joint might open. Since the cement contains several chemicals of different natures, some if the ingredients will evaporate quickly, while the remainder will become sticky and tacky. It is, therefore, necessary that the splice be made as quickly as possibly after the cement has been applied to the surface of the film. Too long a delay will result in a bad splice with the possibility of bubbling and an exposed rough

edge. This can cause more problems than just an open splice.

WINDING

Another thing to look out for in cement splices—the magnetic sound track and a film that has been kept wound too tightly on a small hub. The cement can damage the sound track by causing it to lift off the film surface. A bad splice can also cause the film to jump slightly while passing over the mag. head, causing a momentary loss of sound at the splice. You can minimize this by making the splice with the butt edge, the one hitting the mag. head, toward the tail end of the film. This will cause the head to slide a little more smoothly from the higher to the lower edge and possibly preserve a cleaner sound. When a film has been kept too tightly wound, the pressure on the bond may cause it to open easily. A way to avoid this from happening might be to hold the splice together a bit longer than normally to make sure the bond is solid Needless to say, *all* splices should be checked carefully for firmness and rough edges.

It is always true that at least one frame is lost in making a cement splice, so when a smooth tear takes place in a film, over (or through) a frame, it might be more advisable to use the tape method of splicing. Here, too, some problems can come up. A loose edge of tape can stick to adjacent layers of film and come apart or, if the sprocket holes are not lined up evenly with the holes in the film, the film will lose its loop and begin to flutter. One practice that sometimes can cause a great deal of trouble is the carelessness of leaving a rolled up ball of tape from an opened splice) lying on the splicer or on the hand where it can be picked up, unnoticed, on the film. No harm is obvious until the film is played and jams up in the gate.

CAREFUL PRESENTATION

Keeping a projector running smoothly takes a bit of care with the unit itself, but be sure to handle the film with care, too. Wear white lintless gloves when possible, thread and splice carefully, and be sure the film is stored properly. These precautions all go to make a trouble-free presentation.

Sometimes, you"ll notice (during a major presentation, usually), that dirt or hairs or dust show up on the edges of the screen image. Obviously, the dirt is caught in the gate area but how do you get to it without stopping the film? Although it is not usually recommended, one way is to blow, and some people have found a measure of success with this simple expediency. Once in a while, the film picks up the dust at a splice and carries it out of sight. One way to get the dirt out is to moisten two fingers and holding them gently in such a manner as to have the film pass through between them right after the film leaves the feed reel. The moisture will help, in many cases to move the dirt out. A similar, but better, treatment is to use a lintless cloth and a drop of film cleaning fluid. A dampish white cotton glove will also do the trick. If the dirt is noticed during a projector check-out with no film running, use a cotton-tipped stick and a bit of alcohol to clean the gate area and film path, remembering that if the dirt is on top of the screen image, the dirt is on the bottom of the gate, etc., due to lens action.

A good cleaning solution and a lintless velvet cleaning cloth should be used to clean the film. This should be done as often as needed, according to the successive usage of the film. If the film is used a great deal, it might be well to leave the film tails out after a showing. The film can then be rewound on a table and cleaned at the same time with a velvet cloth held gently over top and bottom. (Many film rental companies request that the film be returned not rewound so that they can clean it while getting it ready for the next user.) This method will also allow the film to be checked for broken sprocket holes, bad splices, and rough edges . . . which should be repaired immediately before finishing the rewinding or the film may be damaged beyond repair.

When cleaning of films becomes a large part of the film operation, it might be wise to investigate the purchase of a film cleaning machine instead of sending the films out all the time. About a half dozen companies make different types of film cleaning machines running from about $300 for the simplest manually operated one to more than $8,000 for the automatic model that is self-checking before the cycle is started and rewinds up to 3,000 feet of film per minute.

You pays your money and takes your choice, but if you don't care for your films and neglect them, it surely can become an expensive proposition making up new copies of films for those that get ripped or damaged beyond playability—not to mention your getting chewed out at the next presentation you helped louse up. ■

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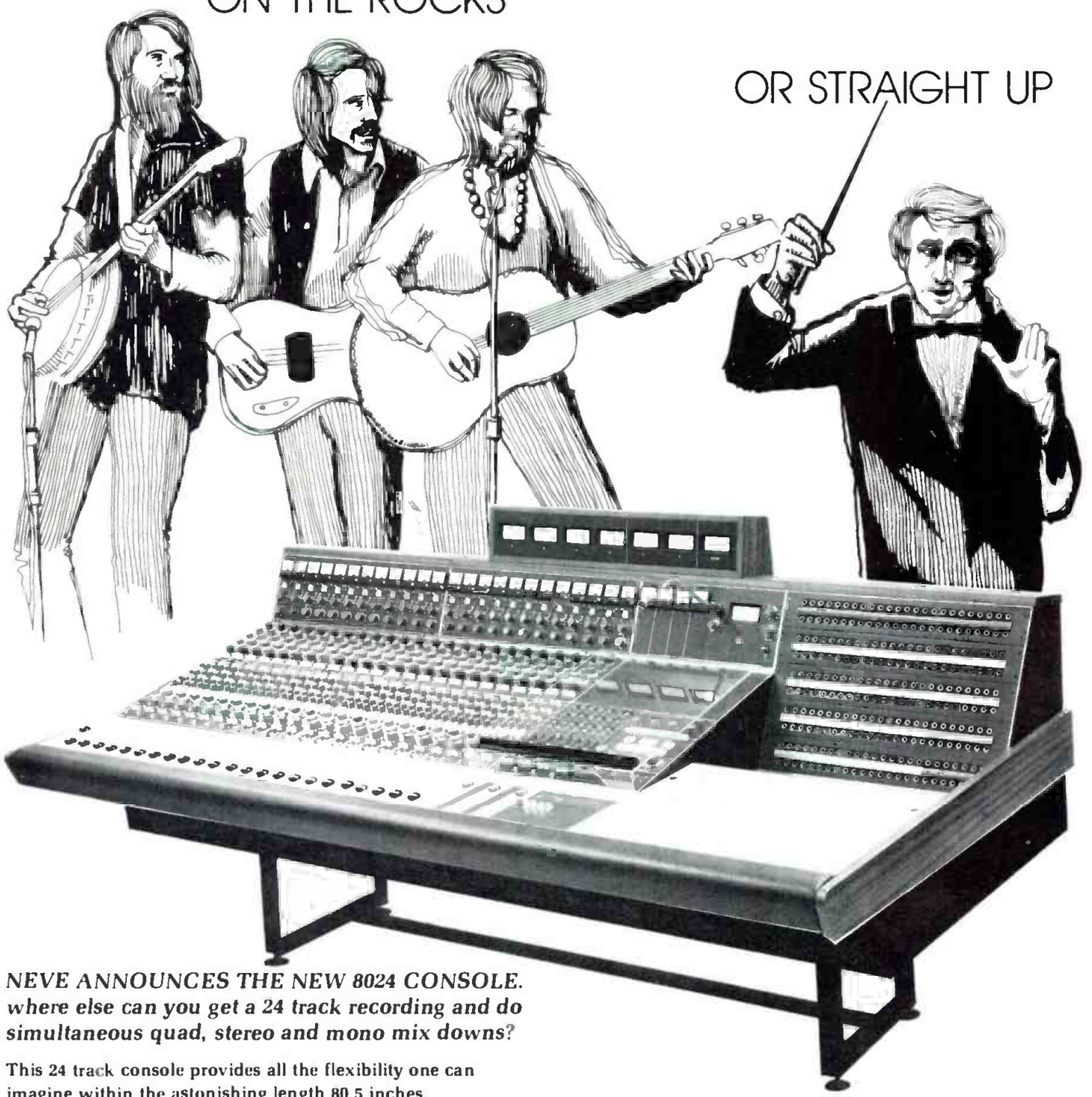

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CARTRIDGE/CASSETTE DUPLICATING SYSTEM

● A duplication ratio of 32:1 with a master tape speed of 240 in/sec is claimed for model 1100B cartridge/cassette duplicating system. Other improvements on the manufacturer's previous model include a short-circuit proof, 2 mHz, 45-watt bias system. Level, equalization, and bias controls are accessible from the front of the master panel, while record level and bias controls for each slave are built into the quick-change head assemblies. The removable loop bin has been redesigned for easier loading and unloading and smoother tape movement. Model 1100B will duplicate 4- or 8-track 1-inch or 4-track ½-inch masters on 4- or 8-track cartridges, 2- or 4-track cassettes, or 2- or 4-track reel-to-reel tapes.
Mfr: Audio/Tek, Inc.
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CROSSOVER/AMPLIFIER

● C100 series of electronics includes a 120 W power amplifier, a four-channel mic mixer with three position EQ, a two way electronic crossover and a pre-amplifier for electronic instruments. Rack assembly measures 3½ x 19 inches.
Mfr: Community Light & Sound
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HEADSET DYNAMIC MICROPHONE

● Designed for sound reproduction in moderate level noise environments, this line of microphones with amplifiers can be used in standard carbon microphone input circuitry. The headsets are designated models 103BB, 803BB, 723HB, and 713HB. The amplifiers are self-powered from carbon mic exciting sources and are not polarity sensitive. The same company also offers a selection of modules for headset intercom systems which can be installed in standard electrical outlet boxes or panel mounted.
Mfr: David Clark Co. Inc.
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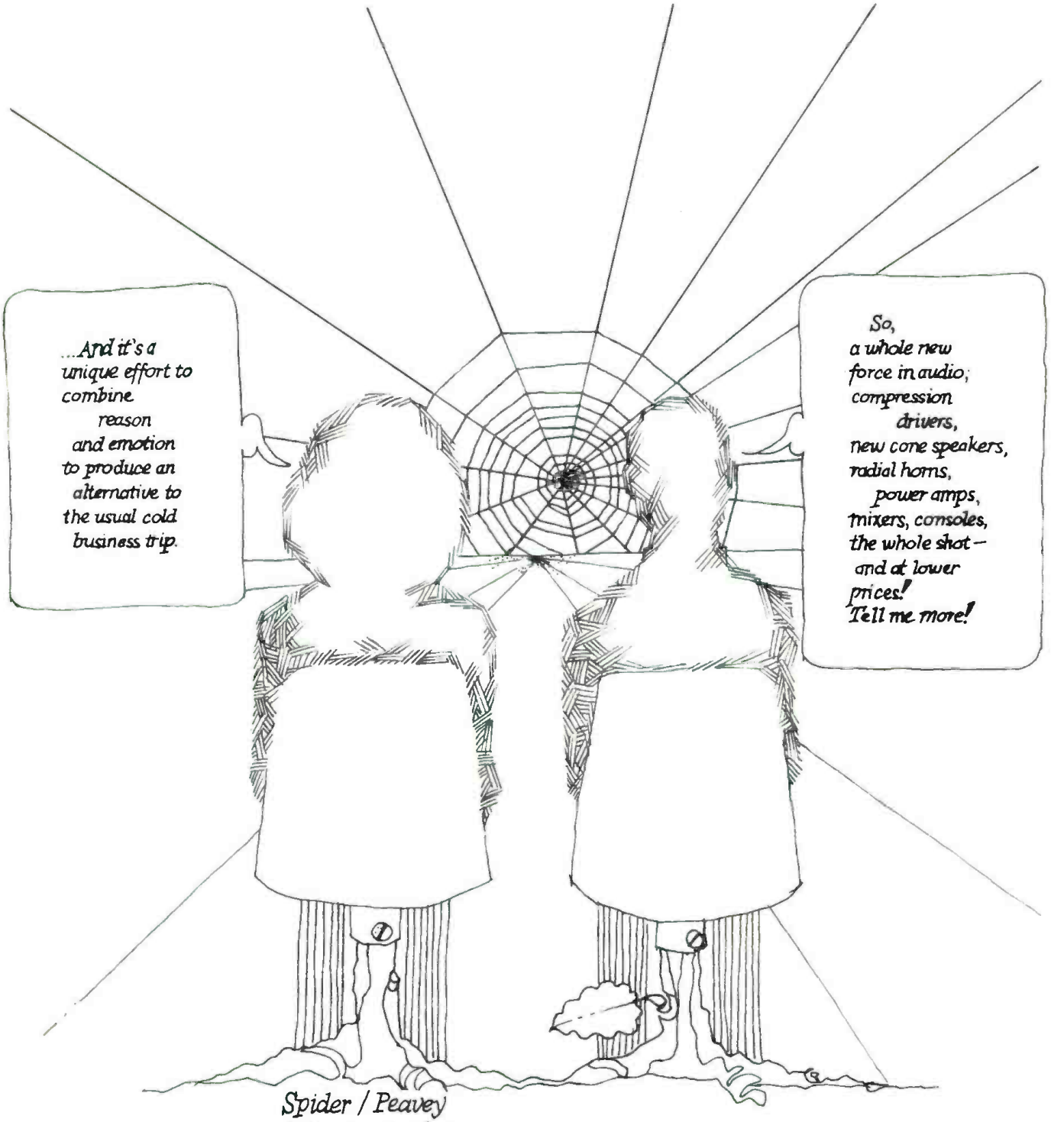

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new products & services (cont.)

STEREO LOUDSPEAKER

• A copper capsule, driven by a magnetic motor and placed between the moving coil and the magnetic pole is a notable characteristic of this series of three loudspeakers, designated models 225, 335, and 445. According to the manufacturer, the result is a modification of the moving coil inductance which makes significant improvements in the performance of the loudspeaker, particularly in mid-range dispersion. The loudspeakers also feature an acoustic flow resistance. Power handling capability of continuous signals and short duration pulses up to 250 watts of power is claimed. Model 225 has a two-driver system with a 10-inch woofer and a dome tweeter. Model 335, a three-driver unit, has a 10-inch woofer and a 5-inch cone unit and operates in a 35 liter cabinet for improved bass reproduction. Model 445 has two separate 8½-inch speakers, the same cone unit as that on the model 335, and a tweeter. The two woofers have different masses and low frequency ranges, avoiding the usual boomy sound of two woofers. Model 445 operates in a 45 liter box.
Mfr: Ortofon
Circle 46 on Reader Service Card

QUADRIPHONIC ENCODER/MIXER

• Employing the CBS-SQ encoding techniques, model SQE-2000 is a-c or battery operated and may be used as an eight-input mixer or matrix encoder of four-channel program material. It can also be used to provide a quadriphonic effect for SQ receivers. It's totally compatible with all stereo and mono receivers, and complies with FCC standards.
Mfr: CBS Laboratories
Price: $795.00
Circle 47 on Reader Service Card

P.C. CARD AMPLIFIERS

• Low noise equalized preamplifiers models AT-27 and AP-27 are designed for conventional magnetic tape heads or phone cartridges. Model AT-27 provides the standard NAB tape reproduce head equalization for tape machine speeds of 3¾, 7½, 15 and 30 in/sec. by adjustment of its low and high frequency trimmer controls. An adjustable gain trimmer control sets the desired operating level. Model AP-27 provides the standard RIAA phono reproduce equalization. High frequency and gain adjustment trimmers compensate for losses due to stylus wear and set the desired operating level. Model 1731A audio operational amplifier is utilized as the active element in the AT-27 and AP-27 and provides the circuitry with an equivalent input noise of —125dBm.
Mfr: Modular Audio Products
Circle 48 on Reader Service Card

DYNAMIC CARDIOID RIBBON MICROPHONE

• The manufacturer claims a cardioid pickup pattern for model MB-301 which suppresses even the lowest frequencies at 180 degrees. The design and dimensions of the basket cause it to act as a windscreen to protect the lightweight horizontal ribbon. Nonlinear distortion is claimed to be inaudible. Impedance is 200 ohms, frequency range is 30-18k.
Mfr: Dobbs-Stanford Corp.
Circle 49 on Reader Service Card

The new Volumax® Model 4300.

Anything else is a limited limiter.

When it comes to automatic peak controlling, the new Volumax is the smoothest operator around! It's the latest in our quest for the ultimate AM limiter. The only similarity between the Model 4300 and conventional peak limiters is that they both prevent overmodulation. And here the similarity ends!

Volumax patented control action assures maximum utilization of each watt of carrier power, without overmodulating the transmitter and with absolute minimal signal distortion. The Model 4300 features: more precise limiting at maximum allowable limits, easier set-up and proof-of-performace procedures, and extended control range of over 15dB, with less than 1% harmonic distortion.

With automatic peak phasing, negative speech asymmetry is silently inverted for positive modulation to the maximum allowable limit of 125%.

Try a 4300 and listen. You'll see why other limiters are limited. And why we think the new Volumax Model 4300 is the ultimate limiter.

CBS LABORATORIES
A Division of CBS Inc.
227 High Ridge Road, Stamford, Connecticut 06905

Circle 16 on Reader Service Card

AMPEX HAS A ONE-WORD ANSWER TO FOUR QUESTIONS ABOUT COMMERCIAL RECORDING EQUIPMENT:

AG-440C

Q: Our program material is *monaural*. Our budget is small. What's the best all-around recorder/reproducer for our station?

A: Get an AG-440C. You'll appreciate the way it handles 10½" reels of tape. With capstan servo, end-to-end timing for 30- and 60-minute programs is always reliable enough to bring you up to the network hour marker, and years after you've amortized the investment, your AG-440C will still be delivering top professional performance. Features and options are the same for all one-, two-, and four-channel machines. It's the best value on the market.

Q: We're *mixing down* for stereo releases, and we can't afford to lose the sounds we worked so hard to get. What's the answer?

A: Get an AG-440C. It'll handle everything on the master tape, from the lowest frequencies right up through the top. At 15 ips, response is virtually flat to 25 kHz. And the capstan servo will deliver flutter and wow performance that is as close to the original as can be achieved on any commercially available mixdown recorder. Low noise figures, too, assure optimum mixdown/dubbing.

Q: Our work involves original production for *quadraphonic* material. We need a recorder that can get us started without making any compromises at all in sound quality. How can we get rolling?

A: Get an AG-440C. The four-channel version is a fully professional half-inch multitrack mastering machine with the latest solid-state electronics for extended high-frequency response. You'll appreciate motion sensing, the easy-to-read VU meters, the large level-setting controls, and the high-visibility record and ready indicators. Your tape will be protected, perform better, too, because the heavy-duty transport has an improved tape guidance system for reduced skew.

Q: We've got to squeeze a *multichannel* production recorder out of this year's tight budget, and those 2-inch recorders are just too rich for our blood. How can we expand?

A: Get an AG-440C. The 8-channel version with Sel-Sync™, automatic monitor switching, automatic tension adjustment, capstan control options, transport remote control, and tenth-of-a-second start/stop will make you a big-leaguer in the one-inch circuit. And, of course, when you go all the way with an AG-440C-8, you'll be ready for all of the previously listed studio operations. Just drop in the right head assembly and get on with the profitable activity.

Information about all the Ampex AG-440C models is available from your local Ampex distributor. Many configurations are now available from stock. Ask for a demonstration today or send for our literature. Ampex has the answer to every sound recording question, and the answer is AG-440C.

AMPEX

Ampex Corporation
Audio-Video Systems Division
401 Broadway, Redwood City, CA 94063, (415) 367-2641

Circle 26 on Reader Service Card

GLENN D. ROGERS

Audio in Montreal Alive and Growing

Top quality sound work and equipment distinguish the audio industry in this part of French Canada. Montreal is already preparing for the 1976 Olympics.

FOR SOME TIME NOW, we've been aware that a good deal more than frigid weather has been coming down from French Canada. So recently we packed our woollies and headed for Montreal, the seething metropolis at the base of the Laurentian Mountains. We found an enormous amount of audio activity, and pride in Canada's contribution to modern sound. It would be impossible for us to report on all of it in one article, or even to touch adequately on the most important sources. So here's a taste, with a touch of Gallic flavor, dipped from the diversity and abundance of sound activity in Montreal.

The control room at Studio Tempo boasts Montreal's only Westlake design.

STUDIO TEMPO

A former fur storage vault with double-thick walls and high ceilings was a natural setting for pop studio, Studio Tempo. Unfortunately, street widening is cancelling that out; they'll be moving in 1976 to an unused theater. The 24-track facility is owned by three musicians, Yves La Pierre, a commercial producer, Francois Cousineau, a t.v. band leader for the CBC, and Bernard Scott, also a commercial producer. The chief engineer is Michelle La Chance. Our guide was Tom Montgomery. Studio Tempo bases its operations on a Westlake design. They utilize an MCI 2-in. 24-track and MCI ¼-in. recorders, several Ampex 440s, a UREI 963 digital metronome varispeed for film sync, and full Dolby. This all comes through a Neve 24-track console. (Neve and MCI are very popular in Canada.) Studio Tempo uses a drum cage with, they claim, over 25 dB isolation. Monitor treatment is custom J.B.L., the usual Westlake style.

Thirty percent of the recording done is for commercials, and the rest devoted to popular albums. The studio, which accommodates about 17 musicians, records artists like Mahogany Rush and Dianne Dufresne, a well-known Quebec star.

LISTEN! AUDIO PRODUCTIONS

The Canadian Parliament has restored a portion of old Montreal. There, amidst cobbled streets and archways, one enters a 200-year-old courtyard flanking Youville Stables in which are quartered, not purebred horses but an ultra-modern studio called Listen! Audio Productions, operated by Stan Brown and Greg Morris. The studio corrals some of the most prestigious commercial accounts in Canada, including Chrysler (U.S. and Canada), Coca Cola, and Ford.

The 8-track facility is set up with Neve and McCurdy consoles. While we were there, they were expecting a new 16-track MCI and will expand their Neve console. We saw an array of Ampexes and an ARP 2500 synthesizer under glass. In addition to the two studios, there are rooms for tape duplicating and editing. Greg Morris, by the way, is something of a celebrity in Canada. Not only is he a former yo-yo champion, but he is known as "The Voice of Canada." He, is heard on hundreds of voice-overs on radio and television.

LE STUDIO, MORIN HEIGHTS

A drive 40 miles up north into Laurentian ski country brought us to a beautiful contemporary structure atop a small hill, facing a serene lake and surrounded by 200 acres of land. This is the new Andre Perry operation, Le Studio. After being inspected by a pair of Chinese ducks who roam the premises, we entered an inviting lounge complete with capuccino coffee machine, pinball machine, and kitchen. To the left rear is the control room, with a large expanse of glass showcasing the studio. The large studio boasts a sloped ceiling, ranging from 10½ to 16 ft. high. There is a drum cage and two other enclosed booths for acoustic guitars, etc. Included in the equipment is a 9-ft. Yamaha piano.

Throughout the building, a great deal of wall glass treatment is utilized for maximum natural light. A massive $100,000 TRIAD-AD "A" console dominates the control room. This English-built 28-in/42-out board is the only one in use in North America and one of four in the

Stan Brown, shown here in one of the studios, operates Listen! Audio Productions with Greg Morris.

world. Its capabilities include PPM *or* vu meter reading during recording, four foldback and six echo channels, equalization in all modes, in and out, and direct board selected tape assignment (without jack cables). Tape equipment includes a 24-track MCI 2-in., two Studer 4--track B64s (full Dolby) with two more on order. Downstairs, there are two separate rooms designed as echo chambers. MacIntosh 2105s power the hidden custom J.B.L. 4320 monitors.

Le Studio has been in operation since September, 1974. The concept here is to provide a total musician environment, similar to Caribou Ranch, but more continental in approach that attracts prominent international artists. According to Mr. Perry, they are in the process of signing such artists as Leon Russell, Nazareth, and Leonard Cohen and they're working on getting Elton John to visit the studio. Next year, Andre Perry hopes to acquire another 50 acres and construct plush live-in quarters for the artists. Although the unique setting and complete facilities are bound to attract a large international clientele, Andre is also very concerned with promoting the talent in his native city.

STUDIO SIX

A computer runs the show at Studio Six. Chuck Gray and Judy Burritt incorporated it into their Neve 24/8 over three years ago and have been modifying it continuously. The mixdown computer records all adjustments, levels, eq. changes, and just about everything else done during mixdown in real time, and commits this to dynamic memory on 32 faders. During any subsequent recording, the whole process can be duplicated exactly by tape playback.

This is all skillfully operated by Quentin Meek, who, aware of the controversy surrounding the automated mixdown concept, says creative effort is increased rather than diminished by the utilization of the subtle and refined changes this system allows. According to Judy Burritt, the automated system has brought them economy of operation which is reflected in lower rates to their customers.

At present, 90 percent of their business comprises French-Canadian recording artists. However, they handle such performers as Jesse Winchester, who is gaining international prominence. Besides album recording, Studio Six does live concerts and simulcasts with touring and local artists affiliated with CHOM-FM, a popular underground rock station in Montreal. Their equipment includes a Dolbyized MCI 16-track, Scully 8-track, Ampex 440, Oddessy Arp and AKG echo. Crown DC-300s drive J.B.L. 4350 speakers.

Le Studio, Morin Heights, located in the picturesque Laurentian ski country, is an example of total studio design.

A view of the control room at Le Studio shows the Triad-A console. The studio is shown through the glass at the left.

SON QUEBEC

A 19th century church is the setting for Son Quebec, the largest studio in Montreal proper, recently acquired by Pierre and Andre Bruneau. Since our last visit, a smaller new studio has been added to two original studios, with a Neve 10-track and 4-track Ampex for radio commercials. Ampex M1000s, 16-track Dolby, dbx, Arp synthesizers, and 440Bs fill the other two studios. There is a drum cage in the large studio and a two-way mirror to the control room, used for private interviews for marketing applications. Although 60-70 percent of the recording lately is albums, film sound tracks are also a specialty of this operation.

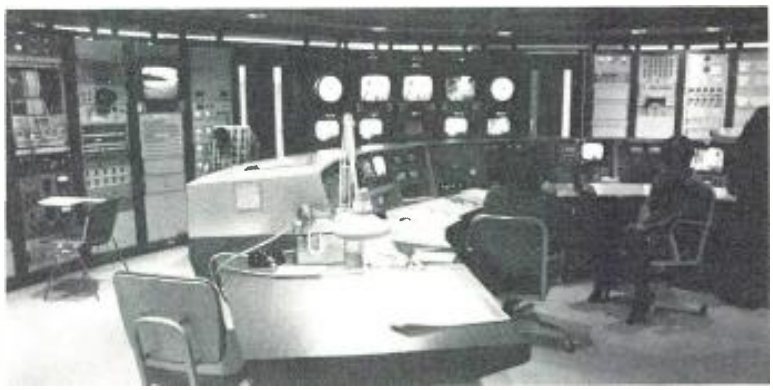
STUDIO MARKO

Studio Marko is the oldest studio operating in Montreal, a 16-track facility with Studer recorders and Auditronics and Neve consoles in their three studios. A great deal of film work is done here, using interlock sync systems and a sound effects console. Jean Marc Audette does voice-overs and lip syncing at this studio. CBC also uses Studio Marko for some of its work.

While this completes our tour of Montreal recording studios, it by no means covers everything working here. RCA has one of its studios here. There are also a number of 8-track and smaller studios available for demo and other lighter recording tasks.

SNB DISC MASTERING

Sampling Montreal's disc-mastering capability, we visited SNB, owned and operated by Sabin Brunet. SNB employs a complete Neumann system, including an SP-72 disc transfer console, VMS-70 computer lathe, and SX-68 cutter head. The hand-built Gotham-Telefunken Magnetophone 15 preview machine carries the master tapes alongside a Studer, which Sabin uses for simultaneous tape copying and eq. adjustments. He also has four Dolby A361s.



The main television control center is located in the center of the CBC complex.

CBC is one of the largest broadcasting complexes in the world. Shown here is the 23-story tower.

Sabin, who is one of the two independent cutters in Canada and a former London Records mastering engineer, told us that in his first year of operation he has mastered over 300 l.p.s, 600 singles and many tape duplicates for such companies as Polydor, Capitol, Barclay, and Trans Canada. As we observed Sabin working painstakingly in his ultra-clean environment, we could well understand why these firms entrust their work to him.

CBC—MAISON de RADIO-CANADA

We didn't just drop in on CBC. One doesn't. There's the flurry of official appointments and guides. And that's a good thing, for it would be simple to get lost in the maze of Canada's largest broadcasting complex. The CBC building, designed on three mammoth levels and an area occupying 23 floors in the main tower, is a cornucopia of t.v. and radio studios, offices, sound stages, theatres, control rooms, scenery building areas, etc. The government-owned corporation handles all phases and distribution in several languages through radio stations throughout Canada, which it owns outright.

We were given a comprehensive tour through all the a.m. and f.m. facilities by Jerry O'Dowd and Real Labelle, instructors in charge of training technicians, in the 2 year old operations center, 140 of whom work in 29 studios offering English, French, and Eskimo broadcasts as well as news in eleven languages. There are f.m. stereo studios set up for 8- and 4-track recording. One of the larger radio studios can accommodate over 60 people. The largest t.v. studio, in fact the largest in the world, seats several thousand viewers.

Remote capabilities are almost unlimited. These are frequently used to pick up performances from the Place des Artes, Montreal's huge contemporary cultural center. Because of the widespread nature of much of Canada's population, it was natural for the broadcasters to turn to a satellite system, the ANIK, the only independent intranational system in the world.

In the radio studios, one sees McCurdy, Philips, Schlumberger, and Ward Beck consoles with Ampex tape recorders used almost exclusively. Eighteen separate telephone lines for on-air interviews are found in seven of the studios. There's a whole room of duplicating equipment, producing in excess of 125,000 tapes a year, largely for the Canadian armed forces. CBC is also readying itself for the 1976 summer Olympics, to be held in Montreal; but more about that later.

CFTM-TV

French station CFTM (Tele-Metropole) is one of the two largest independent t.v. stations in Canada. Jules Blais, assistant technical director, showed us the facilities of the 13-year-old station, which has 600 employees. Six studios each have their own consoles, with a master control room monitoring each camera. Ampex 1200s, 2000s, AVR-1s and ECR-25s are found in the vtr room.

CFTM, with its own complete film systems, processes all its own 16mm film, photos and slides. RCA and GE film and slide projectors are used. One studio is in con-

Quentin Meek of Studio Six is seated at their automated mixdown console.

Sabin Brunet operates his Neumann SP-72 disc transfer console at SNB. Behind him is the computer lathe.

One of the studios at CFTM-TV. A talk show similar to Merv Griffin's is taped here daily.

ORTO's specially prepared auto-camera is given a test run in preparation for the '76 Olympics.

tinuous use, seven days a week, producing commercials under the aegis of a separate production company. The studio owns three fully equipped CINE mobile trucks with all the latest equipment, including slow-motion gear.

A new building is under construction, adjacent to the present facility, which will almost double the present space, adding new offices and two new studios. Mr. Blais told us that negotiations are presently under way for the creation of a Westlake design recording studio.

ORTO

Montreal, which has been selected as the host city, has formed an autonomous organization, known as ORTO (Olympic Radio and Television Organization) to handle the projected 1976 Olympics. A division of CBC has set up headquarters in the old Radio Canada building with a budget of $56 million and work force numbering 1,500. According to Roger Nissenbaum, an ORTO public relations officer, the organization, which was set up in 1973 with the help of the city of Montreal, the Canadian government, CBC, and other Canadian networks, will handle the following: (1) TV coverage of the games; (2) TV and radio commentaries; (3) a central broadcast center for routing, switching, recording, film facilities, etc; (4) TV and radio facilities at a cost to the user for packaging of individual program needs (i.e. ABC-TV-Radio); (5) transmission of national programs to the respective broadcasting countries.

To cover the 32 different sports at 26 locations participating in 3,000 events, they estimate that they will require the following equipment: 20 mobile units, 79 vtrs, 107 cameras, 10 slow-motion vtrs, 14 telecine chains, 730 commentator units (300 of these for radio), 4,500 audio circuits, 35 video circuits, 50 radio studios (each containing 3 Ampex 440¼-in. and 6/2 custom consoles), 10 t.v. studios, 110 offices, and a t.v. and radio distribution center. Most of the equipment is being leased.

Specialized equipment is being readied, such as custom built ramps, overhead cameras, and special trucks, including a super customized Volkswagen with a Porsch engine called the auto-camera. This will follow the bicycle road race; used in conjunction with a helicopter, it will reach positions to record the cyclists within a few feet, hopefully to produce the best pictures ever achieved of a cycling event.

THE FORUM CONCERT

A concert featuring Elton John and the Kiki Dee band in the 22,000-seat Forum gave us an opportunity to see how sound reinforcement is doing in Montreal. Sound for the concert was in the hands of Clair Bros., a sound contract company out of Lititz, Pa. Gene Clair showed us the equipment, which included 16 Phase Linear 700B amps and four SAE amps to drive 20 4-way custom speaker systems utilizing J.B.L. 2440 and 2405 drivers in an ear-shattering display of 22,000 watts. Gene's own custom audio mixing console handled 30 inputs and, used in conjunction with a 10-input mixer he also designed, carried a total of 35 mics. Revox decks, Eventide digital delay, echo, and an array of SAE equalizers provided special effects. Elton John's piano was double-miked with a specially designed piano bar pickup and a Sennheiser 435. The sound was excellent, loud but very clean. In addition to Elton John, the Clair Bros. organization has handled sound for Chicago, Elvis Presley, Yes, and Cat Stevens.

AUDIO ANALYSTS—SOUND REINFORCEMENT

During our visit to the Forum we met Peter Pare who, with his brother Bert Rand, operates Audio Analysts, the largest sound reinforcement company in that part of Canada. They also handle U.S. jobs. Their clients include Tony Bennett and the afore-mentioned Dianne Dufresne. Their equipment comprises Fairchild FPC-50 portable

Gene Clair (left) setting up for the Elton John concert at the Forum. Their custom console (foreground) takes 30 channels mixed to a 4-way system.

Amber's engineering department contains all the necessary equipment for design and Q.C. Shown on the bench is a 4550 Audio Spectrum display.

The Ward Beck console at the National Film Board of Canada can handle up to 96 tracks with its pre-mix sub system.

Bill Edwards at the helm of the Chromacord, in the Montreal office.

consoles, Crown amps, and 4-way J.B.L. systems. With Scullys and Revoxes, they have capabilities for on-location recording. Besides doing live simulcasts with CKVL-FM, they have handled many industrial trade shows for IBM, Chrysler, GM, and Ford. They also did the Montreal version of HAIR.

AMBER ELECTRO DESIGN

Manufacturers of pro audio have not discovered dynamic Montreal to a large extent. We did, however, visit a plant on the Ile des Soeurs, a convenient, but quiet island in the St. Lawrence River, which houses a modern industrial park. Amber Electric Design, Ltd., started by Wayne Jones about a year ago, manufactures specialized audio products, such as the model 4550 Audio Spectrum Display. This originated as a device to solve some problems RCA had in New York. After creating three prototypes and a great deal of research, Wayne discovered that he had a viable product the entire industry could use. Costing $1,800 U.S., this compact ten-octave real time analyzer solves various eq. problems quickly. The solid-state device allows analysis of music programs and system response through pink noise, with capabilities of comparisons through the use of two separate memory modes. The led matrix circuits allow for fast display response. At the spring AES show, Wayne hopes to show a multi-purpose audio generator specifically tailored to pro audio applications combining noise and sweep functions.

CHROMOCORD CORPORATION

Chromocord, distributors and consultants for four years, run by Bill Edwards, provides advice, design, and equipment to many of the studios in eastern Canada, including most of those described in this article. Bill is the exclusive importer of Tri-Ad consoles in North America. He also maintains a good inventory of Ampex, API, MCI, J.B.L., Electrovoice and dbx products, as well as many others. He now has branch offices in Toronto and Plattsburg, N.Y. One of Bill's largest customers is the CBC, who buys on a day-to-day basis. The firm maintains its products in its own well-equipped lab and provides on-location installations and calibration.

NATIONAL FILM BOARD OF CANADA

Showcasing Canada to its own people and to other countries is the business of the National Film Board, headquartered in Montreal. Since 1939, the Board has been involved in a wide range of films, including several highly touted documentaries which were shown in the U.S. Although the headquarters contains three theaters, sound stages and offices, most of the shooting is done on location. We met with Claude Pellitier, acting chief of sound and his staff, who supplied us with enough information to fill a book.

Although the staff numbers 1,000, when it comes to shooting a film, ingenuity and nimble feet often have to substitute for a large crew. For example, during a documentary of a Rod Stewart concert, one sound technician handled a Stellavox recorder, stereo console, and 20 mics while another ran through the crowd doing interviews. Distributing their films world-wide, the Board produces in 32 languages, including three Indian dialects! All Canadian embassies maintain complete film libraries, which supply films upon request.

Technically, a research division constantly tests and improves the application of equipment. With the heavy use of Nagra tape recorders, for example, improvements were made which Nagra later made permanent. The Board also publishes SMPTE papers on film sound development techniques and provides technical bulletins to the AES.

Mr. Pellitier showed us one of the theaters used for sound track recording and film presentations. In the back of the theater is a Ward Beck console, which utilizes a premix sub system providing up to 96 tracks on hand. Walt Disney Productions leased this system for producing over 40 tracks for the Cinisphere, an attraction at Disney World. The console, totally remote, controls 16mm recorders a block away.

As might be expected, the Film Board is already deep into the 1976 Olympics, working with ORTO as the official film production company.

The audio industry is alive and growing in Montreal. Those who showed us around were extremely gracious and evidenced a pride in their city and their work. We are particularly grateful to Wayne Jones of Amber and to Bill Edwards of Chromocord who not only arranged interviews for us, but drove us around as well. We expect in the future to hear great sound coming down from the north, infused with the energy and alertness of audio people who are interested not only in quantity but quality. ■

GEORGE L. AUGSPURGER

Versatile Low-Level Crossover Networks

The procedures in creating a biamplified approach to sound reinforcement are not insurmountable when you know exactly what you're doing. Here are some ideas telling what works and why.

BI-AMPLIFIED MONITOR LOUDSPEAKERS seem to be coming into their own. Altec, JBL and Electro-Voice offer standard models designed for multi-channel amplification. Several studio supply firms, such as Westlake Audio and Spectra-Sonics, offer their own bi-amplified or tri-amplified monitors. When designing custom monitor or sound reinforcement loudspeaker systems, I try to use the bi-amplified approach whenever possible.

Some published articles extol the virtues of separate power amps for low- and high-frequency channels. But many of the authors seem to hase their arguments more on wishful thinking than on convincing evidence. Substituting a textbook-designed low-level network in a loudspeaker system originally engineered for a high-level network may make its performance worse instead of better.

Nonetheless, there are a number of clear advantages to bi-amplification, particularly for high-power loudspeaker systems. These include more efficient power transfer, less i.m. distortion from the power amplifiers, elimination of loss-type pads for halancing hf and lf levels, and avoiding the frustration of trying to find tight-tolerance, high-power, low-loss, low-distortion capacitors and inductors at reasonable cost.

For custom loudspeaker designs or experimental work, the bi-amplified approach offers additional advantages: Standard, off-the-shelf components can be used. Circuits can be designed with predictable electrical characteristics. There is no interaction between the network and the loudspeaker's impedance peculiarities. And, low-level networks can easily be modified in the field for best results in a given situation.

BUILDING A PASSIVE LOW-LEVEL NETWORK

As an example of the last point, it is simple to build a passive low-level network having several switchable crossover frequencies. FIGURE 1 shows the familiar 12 db/octave (2nd-order Butterworth) network. This is a "constant-resistance" network, which means that, when properly terminated, its input impedance is resistive and unchanging at all frequencies. Such a network, for instance, can provide the correct termination for a string of passive room equalization filters.

Obviously, by switching inductors and capacitors we can provide any desired number of crossover frequencies. But there is a cheaper way!

In most professional installations, the constant-resistance feature has little value. It is easy enough to isolate the

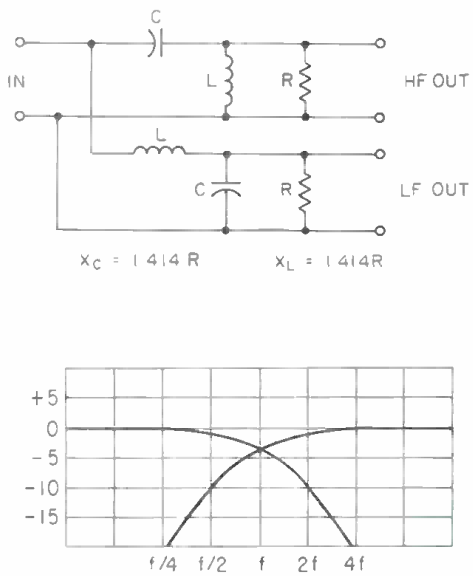
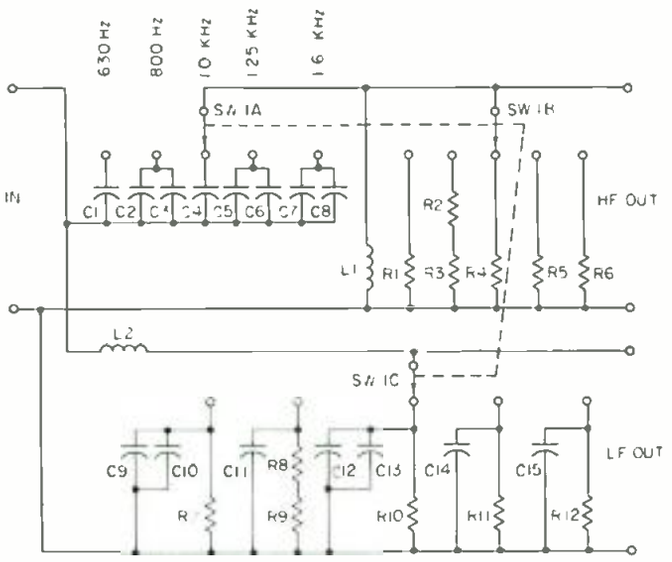


Figure 1. Second-order Butterworth (constant resistance) network provides ultimate slope of 12 dB/octave.

George L. Augspurger is with Perception, Inc. acoustic equalization specialists in Los Angeles



PARTS LIST

C1	.25mf	C9	.20	R1, R7	620Ω
C2	.15	C10	.20	R2, R8	750
C3	.047	C11	.25	R3, R9	33
C4	.10	C12	.10	R4, R10	1000
C5	.15	C13	.06	R5, R11	1200
C6	.47	C14	.10	R6, R12	1600
C7	.20	C15	.06		
C8	.20				

L1	150mH (TRIAD EK-150)
L2	250mH (TRIAD EC-250)
SW1	3-POLE, 5 POS., SHORTING

Figure 2. A circuit providing multiple crossover frequencies without changing inductance values.

network with a buffer amplifier if one is not already included in the console monitor output. Once we have a constant, low-impedance source for the network and a pair of high-impedance (bridging) loads, all sorts of tricks can be played. FIGURE 2 shows a 2nd-order Butterworth crossover network which allows crossover frequencies to be changed without changing inductance values; capacitors and terminating resistors are switched instead. Thus, only two high-quality toroid inductors are required.

The circuit has been worked out to make use of standard component values and has been designed around an impedance range which can be handled by standard 600-ohm line amplifier outputs. Values have been normalized to a center crossover frequency of 1000 Hz. For frequencies not shown, you can scale new values from those specified or go back to the formulas given in FIGURE 1.

SMOOTHER TRANSITION

In some cases at least, slopes steeper than 12 dB/octave give smoother transition between low- and high-frequency speakers by suppressing unwanted interaction through the crossover band. The same technique can be used to design adjustable 18 dB/octave or 24 dB/octave networks, but these become fairly complicated. It probably is more practical to synthesize active networks instead.[1]

However, for the first 15 dB of attenuation, we can closely simulate 3d-order Butterworth curves by raising the terminating resistance of the 2nd-order circuit. If the termination is adjusted to allow about one dB of peaking,

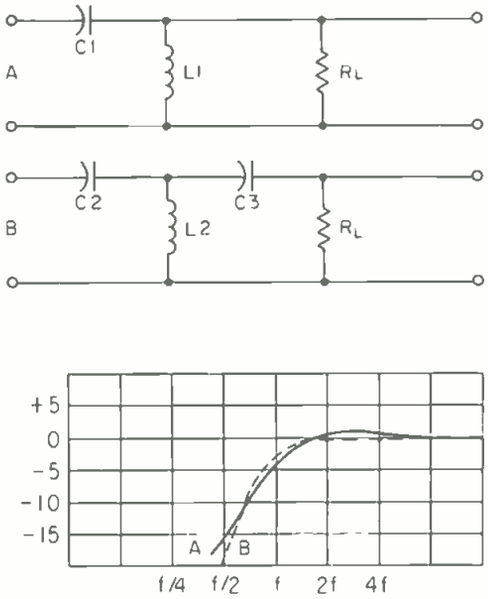


Figure 3. By raising terminating resistance, the response of circuit A (solid line) approaches that of 18 dB/octave filter circuit B (dotted line).

the transfer curve closely matches that of an 18 dB/octave filter, as shown in FIGURE 3. Unless there are some horrendous peaks in the loudspeakers, 15 dB is enough attenuation to get outside the range of noticeable interaction between the two channels. Moreover, the simple change in one resistor produces an effect on nomenclature that is even more impressive than its effect on performance—we now have a 2nd-order Chebyshev filter!

Since loudspeakers don't read textbooks written about them, there really is nothing sacred about a particular textbook filter curve. The fact that we can solder together a 2nd-order Chebyshev filter is interesting. But perhaps something else might work as well or better. The solid curve in FIGURE 3 is only one of a family of curves (including Butterworth, Gaussian and Chebyshev) that result from nothing more than varying the termination of a simple l-c high-pass filter. In a recent **db** article[2], Don Davis has explored the variations in response that result (intentionally or not) from varying the source and terminating impedances of different filter circuits. Using this information, one can do a variety of things with simple filters.

DISTORTIONLESS APPROACH

But first, we should mention the so-called distortionless approach to crossover network design. In the examples given thus far, the crossover frequency is assumed to be that at which the response of both sections is down 3 dB, since this results in constant power transfer through the crossover region. But constant power transfer does not necessarily mean that the output signals can be summed to re-create the original input signal. At least ten years ago it was pointed out that most of the common crossover nework circuits introduce delay distortion.[3]

Richard Small has analyzed the design of "constant-voltage" networks which introduce *no* delay distortion and has explained the theory and circuitry of a number of these.[4] One such design is shown in FIGURE 4. Circuit values are the same as for a 2nd-order Butterworth crossover network except that the terminating resistor for one channel has been moved.

I have previously pointed out that the distortionless feature of this approach does not apply when real loudspeakers are connected because a two-way loudspeaker system is not the acoustical analog of an electrical sum-

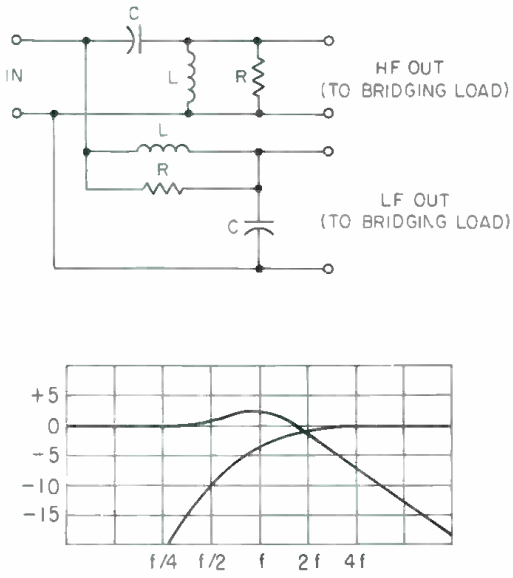


Figure 4. "Distortionless" crossover network duplicates input signal when output signals are summed electrically.

ming junction.[5] But that doesn't mean that the design *won't* work. In some cases, the circuit of FIGURE 4 makes a monitor loudspeaker definitely sound better than when the more orthodox FIGURE 1 is used. Why? Because the response and phase characteristics if the former just happen to compensate for the deficiencies of a particular loudspeaker-room combination.

USING THE LOW-FREQUENCY HUMP

For one thing, several popular low frequency loudspeakers tend to sag somewhat through the 300-800 Hz region. The low frequency hump of the constant-voltage network is all to the good in this instance. Also, some loudspeaker systems sound better with substantial overlap between the ranges of low- and high-frequency units even though this contradicts some published data.[6] There are at least two Los Angeles control rooms using constant-voltage crossover networks for the simple reason that I got better results when the low-frequency load resistor was unsoldered from the capacitor and moved to the inductor.

It would seem then that a truly versatile crossover network should include the low-frequency circuit variation of FIGURE 4 as well as adjustable termination for the more conventional configuration.

For the high-frequency channel, no adjustment in cutoff frequency is desirable since this is pretty well established for horn-type tweeters. For the same reason, no substantial bump in response near crossover should be provided in the high-frequency channel; keeping high-frequency drivers from burning out is enough of a prob-

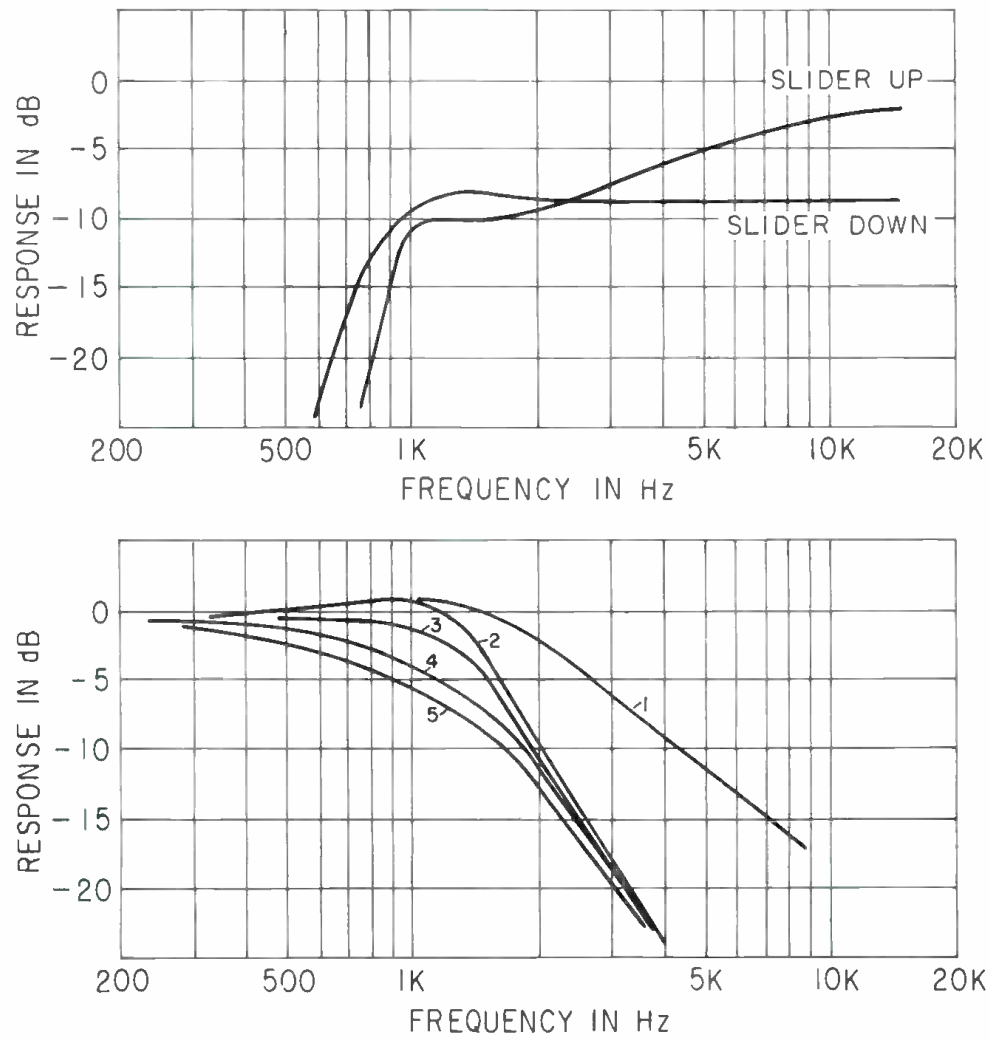
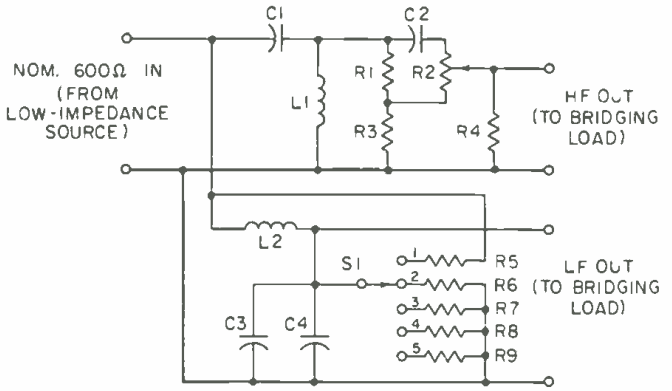


Figure 6. Response at high-frequency and low-frequency outputs of adjustable network.



PARTS LIST

C1, C3	R6	1.8K
C2, C4	R7	2.5K POT
L1, L2	R8	1.8K
S1	R9	1.0K
R1	.1 MFD	910Ω
R2	.022 MFD	1.8K
R3	200mH (TRIAD EC-200A)	1.2K
R4	SINGLE-POLE, 5-POS. SW.	910Ω
R5		620Ω

Figure 5. Adjustable circuit provides a wide variety of curves to compensate for characteristics of loudspeakers and listening environments.

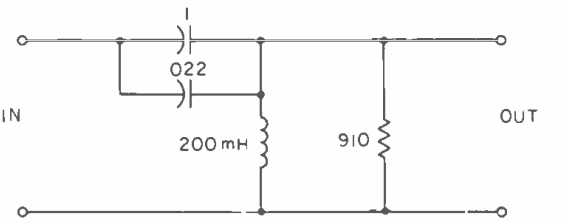


Figure 7. Optional fixed high-frequency circuit for circuit of Figure 5.

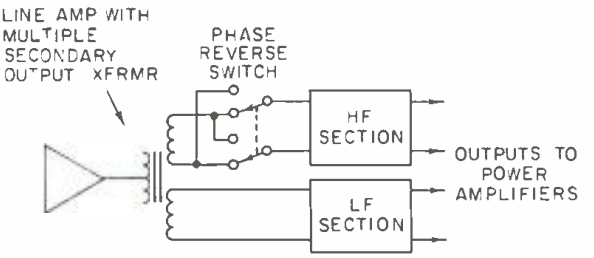


Figure 8. One method of adding phase-reverse switch to low-level crossover networks.

lem even when all precautions are taken. What *is* desirable is a degree of adjustable top end boost, without accentuating the 2 kHz region where most compression drivers are too hot anyway.

FIGURE 5 shows a circuit which provides considerable flexibility with a minimum number of parts. Its response characteristics are plotted in FIGURE 6. With values specified, the circuit works well with typical two-way loudspeaker systems designed for crossover frequencies in the 500-800 Hz range. The high-frequency section allows up to 8 dB of boost at 10 kHz while maintaining the desired sag around 2 kHz. Because the shape of the curve changes as the high-frequency contour control is varied, its 3 dB down point appears to shift substantially. But this is an optical illusion. If the two hf curves of FIGURE 6 are normalized to the same level in the 1-2 kHz region, it will be seen that the nominal cutoff frequency remains at about 900 Hz.

MODIFYING BY SCALING COMPONENT VALUES

The circuit can be modified to provide other crossover frequencies by suitably scaling component values. For example, to shift the curves a half-octave upward without changing the impedance of the circuit, inductance and capacitance values would be divided by the square root of two. If adjustable high-frequency boost is not desired, a standard 2nd-order Butterworth high-pass filter section can be substituted, as shown in FIGURE 7.

Shelving controls are not shown in any of these circuits. Many engineers prefer to use the gain controls of the following power amplifiers. Alternatively, level-set potentiometers can be added at the outputs of the crossover network. For the circuits of FIGURES 2 and 5, the loading presented by any such pot, including the parallel input impedance of the associated power amplifier, should be at least 15,000 ohms.

WOOFER-TWEETING PHASING

When experimenting with crossover network characteristics to get best possible performance from a given speaker system in a given location, it also is necessary to experiment with woofer-tweeter phasing each time a change is made. A convenient way to do this is to provide a phase-change switch as part of the crossover network. If the preceding line amplifier has an output transformer with multiple secondary windings, this feature can be added easily as in FIGURE 8.

To sum up, passive low-level crossover networks lend themselves to simple, predictable changes in their operating characteristics. Therefore, when setting up bi-amplified monitor-speaker installations, it makes sense to provide a range of adjustments in the crossover network. How one determines the optimum conditions for a given situation is a story in itself. A combination of accurate third-octave measurements and critical listening seems to me the best approach. But even without test equipment, a recording engineer can make accurate value judgments between several choices by listening to recorded instruments having considerable information (mainly second and third harmonics) in the crossover frequency region. ■

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RICK BLADES

Solid State Switching for Audio

No need for mechanical switches that are limited by size, capability, and lifespan. Alternatives are: bipolar transistor, photocell, n-junction fet, and p-mos fet.

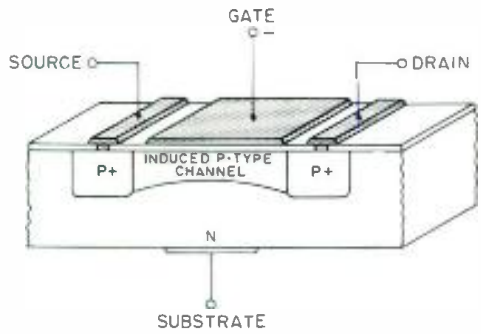

Figure 1. Chip cutaway of a p-mos fet.

THE CONSTANT PROBLEM of switching audio lines is still hampering the design of flexible audio systems. The conventional finger-actuated mechanical marvel that has been used almost exclusively in the past often doesn't afford the flexibility desired in today's systems.

In dealing with audio systems, too often one is confronted with a panoramic view of numerous switches. As we were gifted with only ten fingers, performing the necessary switching function can prove to be a monumental achievement.

First, the physical size in itself must be dealt with. Take for example the common need to manipulate 24 input channels into any combination of 16 tape tracks. You need 384 switches that require a minimum panel area of about 100 sq. in. Usually size becomes a dominant factor, and the switches are too small or too closely spaced to be actuated easily.

Secondly, mechanical assemblies by nature have a limited life span, typically 10 to 500 thousand cycles. After a few years, they begin to deteriorate, often requiring replacement.

Thirdly, and perhaps most significantly, mechanical switches offer only one specific capability. They do not allow for expansions of their facility, such as remote switching, preprogramming of switching status or simultaneous switching of a large number of lines.

If that is not enough, the cost of a good switch can be quite high. One must pay for every feature desired, small size, long life, sealed contacts to avoid noise, a pleasant feel, and so on. The final cost for large systems is usually formidable.

POSSIBLE ALTERNATIVES

As for the alternatives, there are bipolar transistor, photocell, n-junction fet and p-mos fet switching net-

Rick Blades is associated with Audio Logic, in Boulder, Colorado.

TABLE 1. COMPARISON OF SWITCHING NETWORKS

	Mechanical Switch	Bipolar Transistor	Photocell	n-Junction fet	p-MOS fet
ON Resistance	$10^{-2}\Omega$	10Ω	$1k\Omega$	30Ω	100Ω
OFF Leakage	10pA	100pA	10nA	100pA	100pA
Offset Voltage	0	10^{-2}v	0	0	0
Commutation Rate	1 kHz	100 kHz	100 Hz	10 kHz	50 mHz

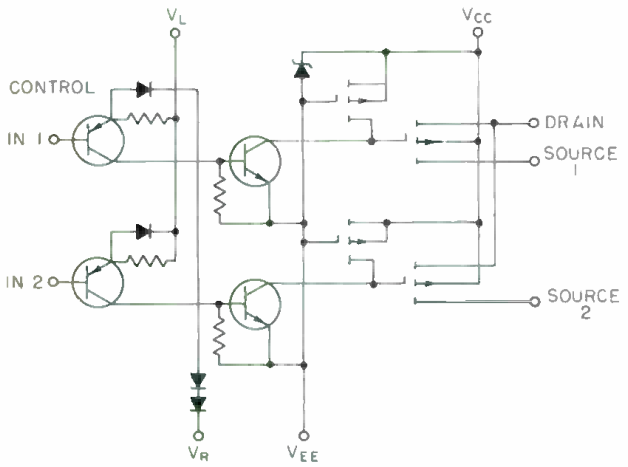

Figure 2. Schematic of ½ Siliconix DG 172 circuit function.

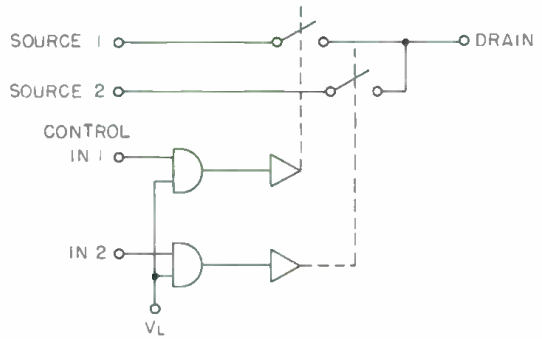

Figure 3. Schematic of ½ DG 172 switching function.

works available, as well as reed switches. Table 1 shows a comparison of the characteristics of each.

P-mos analog switches size up well when compared to other switching devices. They provide a far more versatile and sometimes cheaper building block for switching systems if the designer understands their limitations and exploits their advantages.

Many mos analog switches presently available contain DTL, RTL and TTL compatible drivers with up to 16 switching channels on a single package-integrated circuit. The cost can be typically as low as 63¢ per switch.

Switching action is accomplished through the use of enhancement mode p-mos fets. Although generally four or more switches are included on a single chip, two should be sufficient to illustrate their operation. Fig. 1 shows a cutaway of the chip while Figs. 2 and 3 show schematic representations of the circuit and switching functions, respectively.

A p-mos fet turns on when the gate is biased negative with respect to the substrate by applying a negative voltage between the gate and source. The electrons accumulate on the gate and induce holes (absence of electrons) in the channel region. This converts the n-type channel to a p-type and removes the p-n junctions that were previously blocking the signal path. It is because the channel is "enhanced" that they are termed as such.

When the switch is off, a positive bias is placed on the gate, thus forming two back-to-back diodes that allow very little current to flow. The off resistance is typically greater than 10^{12} ohms.

RULES OF DESIGN

In designing switching systems, the chip can be used as a building block with little specific reference to the internal circuitry. The digital logic interfacing is accomplished internally so one need only be aware of a few basic rules governing their operation for most audio applications.

First, the control signal is a logical zero (0v) or a logical one (5v). A zero on any driver input turns its respective switch on and another turns it off (this varies for each i.c. and is specified with the chip). The switching signal is isolated from the audio. The mos device, in this application, is bilaterally symmetrical. The source and drain can be interchanged as input and output.

The maximum analog input signal for most of these devices is ±10 volts, suitable for most low-level audio. The cmos analog switches can usually handle higher level signals though they will not be discussed here.

The on-resistance varies from about 50 to 250 ohms

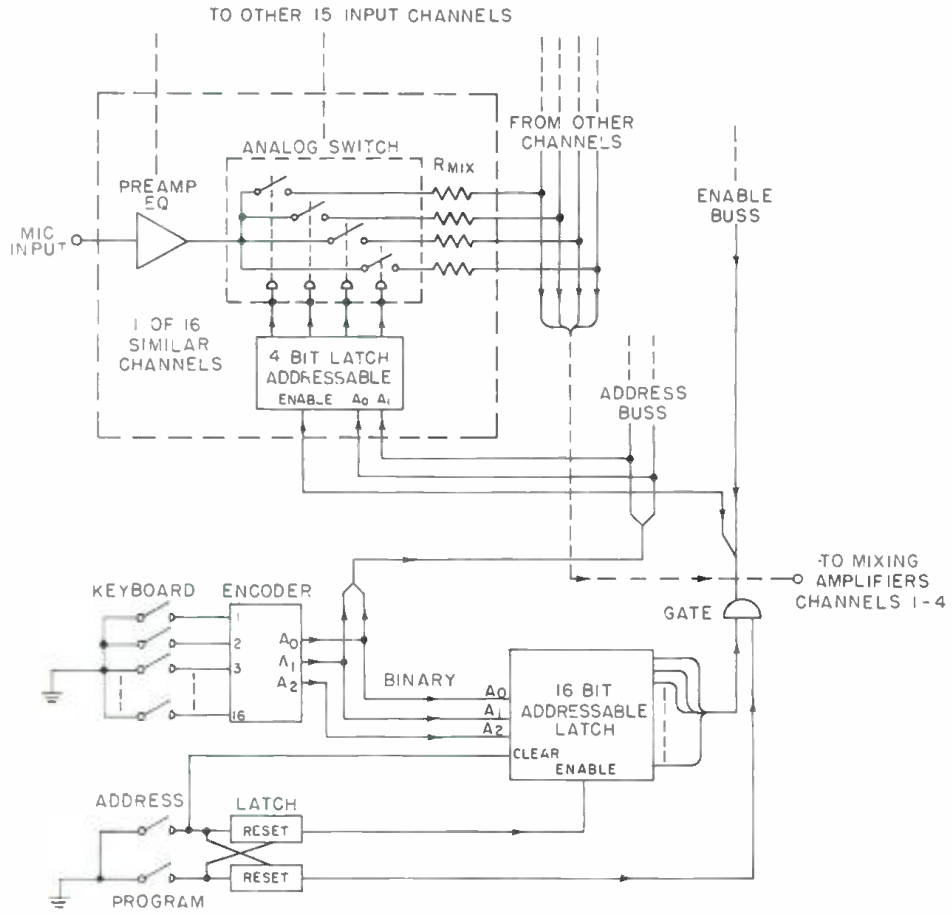

Figure 4. A possible application of analog switches.

as the analog input varies from −10 to +10 volts. It should, therefore, feed a fairly high input impedance to eliminate non-linearities. With the switch feeding a 10k-input impedance, the distortion is virtually non-existant.

The beauty of the device is easily understood when one becomes aware of the numerous switching configurations on a single chip. SPST, SPDT, DPST, DPDT, SP4T, DP4T and other common functions are easily available. Eight and 16-channel multiplexers that can serve as multiposition rotary switches are available. With mos switches continually coming into wider use, the functions available will continue to expand.

Due to the cost of the power supply and digital driving sources, mos switches are economically feasible only for fairly large systems. It is with larger systems that the cost, versatility and expandability can be appreciated fully.

Digital logic in conjunction with mos analog switches can perform complex switching and memory functions quite inexpensively. The logic can be as complicated as a microcomputer or as simple as a keyboard switch to provide anything from full switching automation to practical conveniences.

USE OF ANALOG SWITCHES

Fig. 4 is an attempt to illustrate one of the many possible applications of analog switches. It is a channel selection system for a 16-in, 4-out recording console. Although it may not be economically feasible for a 4-track board the concept can easily be extended to larger systems.

The operation is as follows. All channel assignments are performed on a single keyboard comprising 18 momentary contact keyboard switches. When the address button is pressed, the 16-bit addressable latch is enabled, allowing it to be loaded. Any or all of the channel switches can then be actuated. As the keys are pressed, the respective output lines on the 16-bit latch are forced to an "on" state, remaining that way until the address command is again actuated clearing the latch. The program key is then pressed. This action resets the address latch and consequently disenables the 16-bit latch.

At this point, all the channels that are to be assigned are stored in the latch. Any or all of the 4-tape tracks that one wishes to assign the addressed channels can now be pushed on the keyboard. Now the 16-bit latch ignores the keyboard commands and the appropriate 4-bit latches are programmed. When the keyboard is returned to the address mode, the channel assignments are "remembered" until the particular channel is reassigned.

Of course this is an over simplification of the design but it should suffice to illustrate the concept. ■

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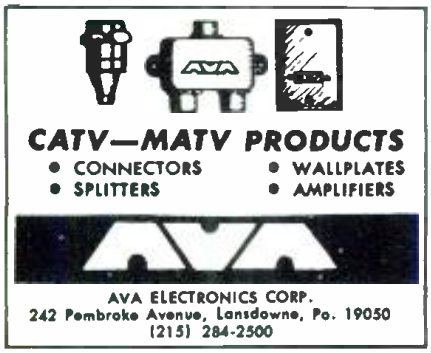

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db people/places/happenings


FAUST


WALTER


DENHAM


SCHUTTE

● A number of new appointments have been made at the **Altec Corporation,** Anahcim, California. **Douglas R. Wagner** has been named administration manager of the international division. In the same division, **Roger Faust** has been promoted to the post of marketing manager, and **Tom Ferrara** as Canadian sales manager. Mr. Ferrara will be based in Willowdale, Ontario. In the sound products division of the company, **Barry Wolfson** has been named to the position of regional sales manager of Metropolitan New York, based in New York.

● Manufacturers' representatives, **Associated Sales Representatives, Inc. (ASR),** have moved to new headquarters at 8706 Wilson Ave., Baltimore. Md. **Philip Walter** will be heading the new office. The move separates ASR, concerned mainly with commercial sound and specialty lines, from allied companies dealing with consumer items with which it had formerly been headquartered. The change has been made for efficiency in administration; the association with others in the **"A" Group** remains.

● The initiation of the Pacific Gateway Center, an industrial development near the intersection of the Harbor and San Diego Freeways in Los Angeles, was marked by the occupation of new premises by **Toshiba America, Inc.** Approximately 50 employees will be housed in the facility, involved in the distribution of Toshiba's consumer audio products.

● The post of national audio products manager at the **Sony Corporation of America** has been filled by **Nick Morris,** who comes from Sony's New York Metropolitan sales force. Mr. Morris will be concerned with the marketing of Sony audio products and with recommendations for the design of merchandise to be sold in the United States.

● **Daniel E. Denham** has been elected chairman of the board of the **International Tape Association** for 1975. Mr. Denham, who is vice president of **3M Company's** recording materials group, had served as president of ITA for the past two years. International Tape Association was formed four years ago to provide a forum for coordination between suppliers and users.

● **Gordon H. Schutte** has been named marketing manager, professional recording and broadcast markets of **3M Company's** audio/video products division. Mr. Schutte joined 3M in 1965. For the past 18 months he has served as marketing supervisor for the professional and broadcast markets.

● A new source for audio and sound cables has been established with the formation of **Consumers Wire & Cable Company,** at 20 N. Wacker Dr., Chicago. The firm is headed by **Sidney Gracen,** former president of **International Wire & Cable Company.**

● The **Glenburn Corporation** has moved into a new 50,000 square foot plant at 4 North St., Waldwick, N.J. The record changer manufacturer has also moved the three production lines of its small plant in England to larger facilities at East Kilbride, Scotland. **Karl Jacobs** is the firm's American general manager.

● **Accurate Sound Company,** distributor for turnkey audio recording studios, of Redwood City, California, has established two branch offices, in Euless, Texas, and in Mexico City under the name of **Amptronic.** The Redwood City facility has also been expanded to provide a complete 16-channel recording and demonstration studio. New personnel added to the staff include **Harn Soper,** heading the creative services group, and **Phil Sun,** in charge of service and engineering.

● Vocational scholarships for children of its employees will be offered by the **RCA Corporation,** commencing with the 1975-76 school year. The program will provide for 20 to 25 scholarships worth from $250 to $1,500 a year to high school graduates who are planning to pursue trade, technical, or vocational careers. Courses covered by the scholarships for a period of up to two years, are to be pursued at accredited vocational-technical institutions or junior colleges. The program will be administered by an independent organization, **Educational Testing Service,** of Princeton, N.J.

● As a step in the implementation of the recent agreement between **MCA** and **N. V. Philips, Norman W. Glenn** has been named vice president in charge of program planning for the MCA Disco-Vision system. Mr. Glenn's immediate objective is to establish both short-term and long-term guidelines for the selection of material for video-disc mastering and replicating. The agreement provides for the manufacture and sale in the consumer market of an optical video disc player by Philips, in association with MCA, who will supply and manufacture the video disc programs.

● After thirty years in the same location, Boston's **Dekko Films,** and its subsidiary, **Dekko Sound Services,** have moved to a new studio at 295 Huntington Avenue, near Northeastern University. The air conditioned production center contains a Magnatech multi-track sound system, a conference room for interlock screening, and departments for film and sound editing, A&B roll cutting, art and animation, studio motion picture and still photography. The new facility was designed by **Bolt, Beranek & Newman.**

● **North American Philips** has secured approximately 84 percent of the outstanding common shares of the **Magnavox Company, of New York. Pieter C. Vink,** president of North American Philips, and **Robert G. Dettmer,** vice president, have joined the Board of Directors at Magnavox. **Joseph N. Ellis,** president and chief executive officer of **LaSalle-Deitch, Inc.** of Elkhart, Indiana, a division of the Magnavox Company, has been named a corporate vice president of Magnavox.

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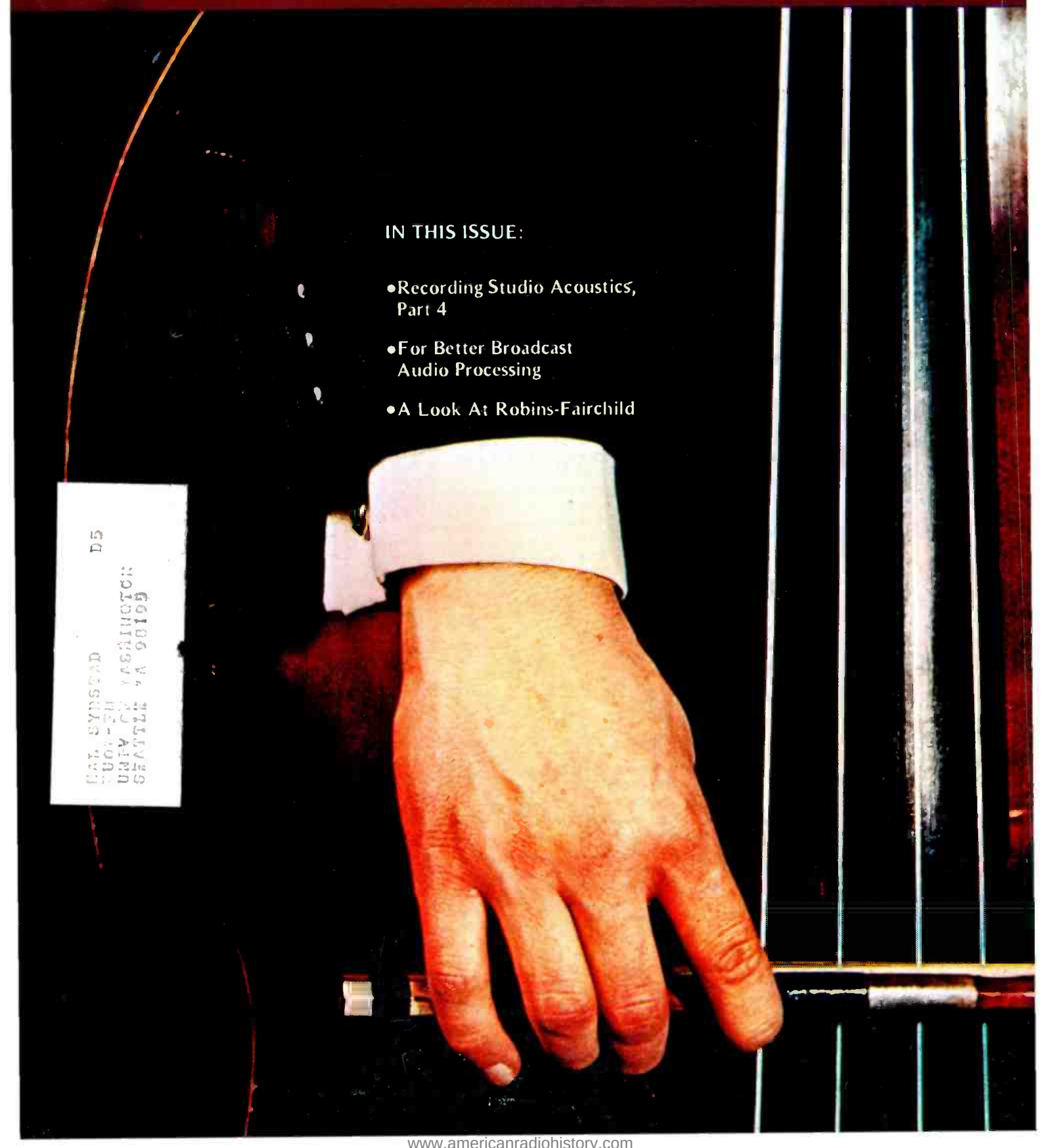

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COMING NEXT MONTH

● March puts the SPOTLIGHT ON MONTREAL, reporting on a **db** visit to the flourishing, sophisticated audio industry up north.

● A simplified economical solid-state switching system, through the use of enhancement mode p-mos fets, is described in Rick Blade's SOLID STATE SWITCHING FOR AUDIO.

● Step-by-step procedures in creating a biamplified approach to sound reinforcement with emphasis on reality rather than textbook theory, including some explanatory diagrams, is offered by George L. Augspurger in VERSATILE LOW-LEVEL CROSSOVER NETWORKS.

ABOUT THE COVER

● This attractive photo, supplied by Bang and Olufsen, is part of a series of slides used in their audio-visual presentation.

db
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db is listed in **Current Contents: Engineering and Technology,**

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GRAPHICS **Crescent Art Service**

db letters

THE EDITOR:

I applaud Mr. Tisdale's article on coincidental miking technique (*Recreating Colonial Sound*, November, 1974). I first started using a crossed stereo pair in 1971 after reading an article by Michael Gerzon in a British publication extolling their virtue. I've had great success with it in recording chamber orchestra-sized groups.

The hall was designed by the same architects who designed the Kennedy Center. With a seating capacity of under four hundred, the auditorium's acoustics were satisfactory for dramatic presentations but entirely too dry for live music. After some experimentation, I found that the optimum position for my crossed pair of RE15s (placed 90 degrees off axis) was a point just in front of and below the balcony, some twenty odd feet back and ten plus feet above the skirt of the stage. The resultant recording was extremely accurate in terms of overall sound and stereo image.

Since the hall was so dry to begin with, some form of artificial reverb would have helped, along with a little eq. on the top end. Unfortunately, I didn't have the facilities to add either. At first I considered another pair of RE15s placed further back in the hall on opposite sides to pick up the room ambience, but the sound was too muddy.

I've also had great success recording small instrumental electric jazz groups with the same method. The only problem I encountered was spillover from heavy footed drummers. With coincidental miking, microphone placement is a snap once the optimum location in any given hall has been found.

KEITH BLOOMFIELD
Scarsdale, N.Y.

CALENDAR

MARCH

3-6 **A.E.S. Convention,** Cunard International Hotel, Hammersmith, London W6. Contact: Mr. E. J. Franklin, A.E.S. Convention, Eccleston Rd., Maidstone, Kent, ME15 6AU. England. Charter flight information: Mr. Bob Lewis, Mirque Travel Agency, 350 Fifth Avenue, New York, N.Y. 10001.

APRIL

5 **Midwest Acoustics Conference,** Northwestern University, Evanston, Illinois.

6-9 **National Association of Broadcasters Convention,** Las Vegas Convention Center, Las Vegas, Nevada.

8-11 **Meeting of the Acoustical Society of America,** Conference Center, Austin, Texas.

21-23 **ASTM Committee E-33 on Environmental Acoustics,** St. Charles, Ill. Contact: Mr. Charles W. Rodman, secretary, Battelle Memorial Institute, 505 King Ave., Columbus, Ohio 432101. (614) 299-3151.

23-27 **SONEX Europe '75.** London

MAY

6-8 **NEWCOM Electronic Industry Show Corporation '75.** Las Vegas Convention Center, Las Vegas, Nevada

13-16 **London International Electronic Component Show.** London.

13-16 **Audio Engineering Society, 51st Convention,** Los Angeles Hilton, Los Angeles, Ca.

JUNE

9-27 **Brigham Young University Audio Recording Technology Course.** Contact: Russel Peterson, Brigham Young University, Audio Recording Technology Course, 242 Herald R. Clark Building, Provo, Utah 84602. Phone: (801) 374-1211, ext. 3784.

JULY

8-11 **INTER NAVEX '75** (Audio Visual Aids in Education) London.

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Gauss-Cetec	1200	Yes	120/240 master 30/60/120 slave	30-12,000 Hz ±2db	Yes	No	$80,900
Ampex	BLM200	Yes	240 master 60/120 slave	50-10,000 Hz ±2db	Yes	Yes	$51,695
Electrosound	6000 8LF	Yes	240 master 60/120 slave	40-12,000 Hz ±2db	Yes	Yes	$69,730
Otari	DP-6000	No	240 master 60/120 slave	30-10,000 Hz ±3db	Yes	Yes	$57,100

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● In an earlier column, we started to discuss room equalization, introducing the notion of using noise as means of taking "real time" measurements of the room's characteristics. Like many other ideas, at first hearing, it seems as if it will overcome all the problems encountered with the old familiar frequency response measurement. But then, either as you theorize a little more accurately, or as you try to put the theory into practice, you find you are merely trading swings for roundabouts.

You can equalize for a transmission link—line or radio—for a recording link, or just for an electronic link, with relative ease, although some of those present their own brand of problems, but when you talk about equalizing an acoustic link—room characteristics—you are in a different ball park. In fact ball park is not not a bad analogy: can you imagine playing galactic football. or baseball, where there is no "ground" to use as a reference plane?

To take a room response, first you put a loudspeaker of unimpeachable frequency response (don't let's argue about that, or we'll never get anywhere) into the room, and let loose some pink noise. Then you pick up the pink noise with a microphone, and analyze what the room has done to the pink noise. Easy, isn't it?

Just a minute. Where do you put the loudspeaker and where do you put the microphone? Well, let's set the thing up, with a real time analyzer, so you can watch what happens, and try a few different spots with both the loudspeaker and the microphone. You find that moving either one has an effect on the dynamic bar graph displaying on the oscilloscope, so you begin to wonder what really is the frequency response of the room, which is what you are looking for.

You realize from this that, although you are not generating the usual kind of standing waves, you do still emphasize some of the same frequencies that a standing wave pattern, with the microphone and loudspeaker in the same position, would emphasize. And this depends, or is affected, more by the microphone positioning in the room than by the loudspeaker positioning, provided you have not done something silly with the latter, such as spacing it at a critical distance from the nearest wall.

So the next step is to use several microphones, to provide an "averaging" effect. Bill Raventos, in laying out the procedure at the Brigham Young University workshop, recommended the use of three microphones. If you realize that your purpose is to average the sound field pickup across the room, you will be guided in placement to achieve that purpose.

Now if an average is to be achieved, each microphone should be set up, its pickup level determined without the others operative, and then the gain should be adjusted so the wide-band output from each is equal in level. When you mix them, the result will give an average of what the three microphones pick up.

So far, so good. But now, you did that with the room or auditorium empty—no audience present—right? What difference will the presence of an audience make? Of course, there is no guarantee that presence or absence of the absorptive bodies of an audience will not make quite a radical difference in the frequency response of the room. A few auditoria have been found in which such a difference is noticeable. But in general, the frequency response of a room or auditorium does not change appreciably when it is filled. What does change is its reverberation time. The sound just "hangs around" longer when the room is empty.

HYPOTHETICAL ROOM SHAPES

This is logical, if you think of the response as being due to the shape of the room. Only if the presence of the audience alters the apparent shape of the room, rather than merely altering its absorption, will the frequency response change appreciably.

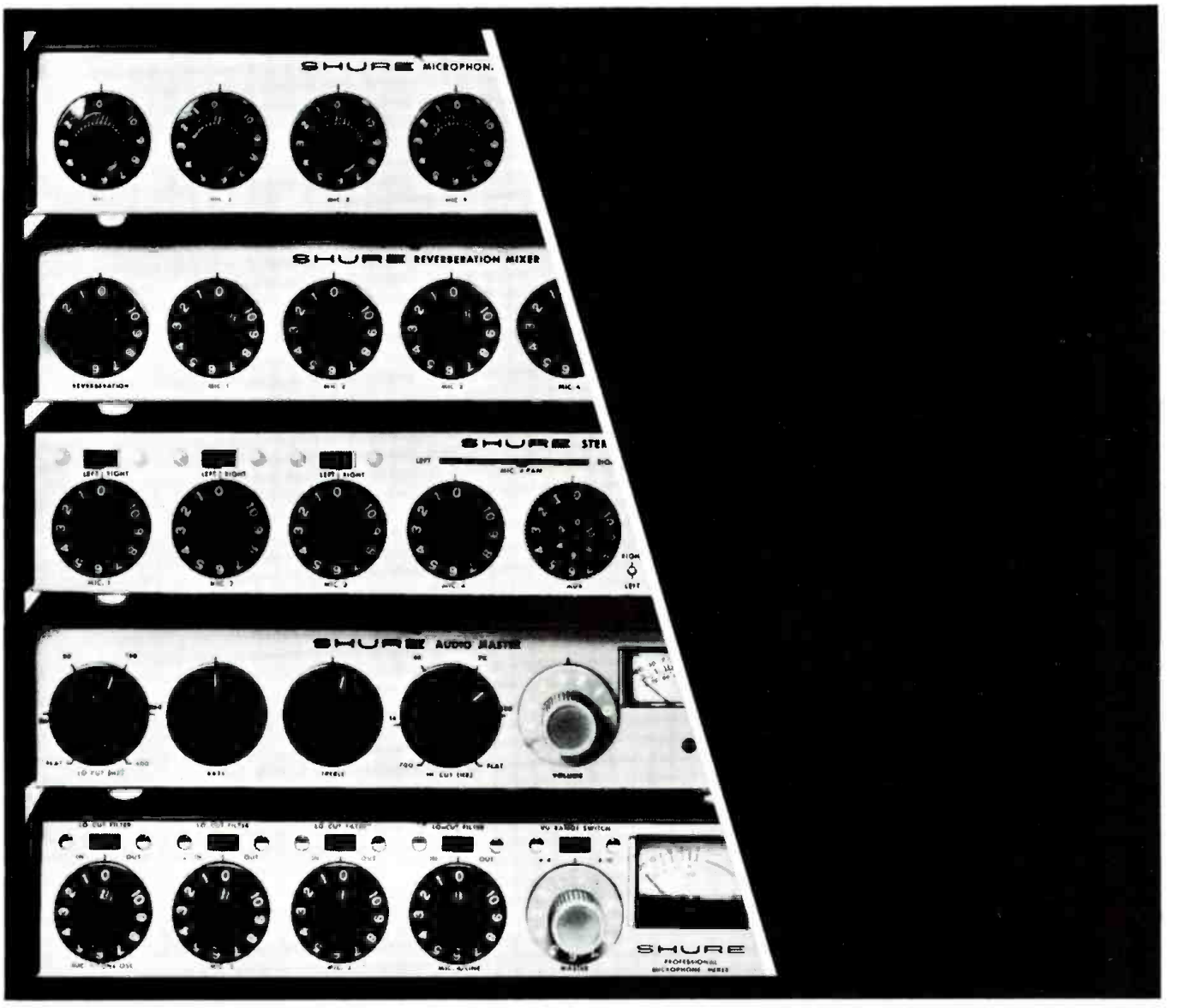
Before the advent of such sophisticated electronics as real time analyzers, making it possible quickly to measure effects empirically, and of high speed digital computers, enabling one to perform a mathematical synthesis of the room's parameters and thus design a room with specified parameters, students relied on ripple tanks to simulate the acoustic properties of hypothetical room shapes.

The problem with that was that a ripple tank can only set up standing waves or determine the response characteristics, due to propagation in a two-dimensional plane. Of course, tanks could be constructed to represent either the horizontal or a vertical plane. But this still did not simulate the behavior of acoustic waves in three-dimensional space.

There are instances in which two-dimensional representation, by parts, so to speak, can give a reasonably good approximation to the three-dimensional counterpart. For example, if you are interested in the characteristics of a fairly large room, whose height does not exceed the 8 to 10 feet of a single building story, its characteristics will be fairly well simulated by a ripple tank representing its horizontal shape.

But such a room does not possess notably good characteristics. A better room frequency requires an irregular shape that avoids the succession of nodes and antinodes. similar to a condition of living inside an organ pipe! Height should vary, over different parts of the room, and as few as possible of opposite walls should be parallel.

When a room has been designed to achieve this. simulating its frequency response with two-dimensional models becomes difficult, if not almost impossible. Response can be derived from mathematical wave equations, but such a procedure, the method used before the advent of high speed computers,



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to run the calculations, is impossibly long.

Simulation with models may be a way to approach the design of new auditoria, to be built from scratch. But the sound reinforcement man more often has to accept a room more or less as is, perhaps modifying it a little with some acoustic treatment, and do the best he can with electronic equipment. That is when the practical approach, using a real time analyzer, is more useful.

Now, what can you expect to find? Rooms have resonances. They can resonate in different modes or directions. This can be affected by choice of loudspeaker placement. To show this, imagine putting a line of speakers along one wall so they generate a plane wave directed at the opposite wall. These will produce a series of peaks and dips, rather like a stopped organ pipe whose length is the distance between the wall where the speakers are, and the one opposite. The other dimensions of the room will have little effect unless you change the wall against which the speakers are put.

So there are these sort of "conditional resonances," that depend on how the room is excited. Then rooms will also have quite definite, but fewer as a rule, frequencies at which a sort of universal resonance occurs: where a peak will show up, no matter how you distribute the sound, or pick it up. These are the resonances that need more important attention in equalizing a room's characteristics.

FALLACIES OF EQUALIZATION

So what have we found? Advocates of room equalization—and we are not opponents of the procedure, we are just a little more conservative about it—adopt the attitude that any room can be made to sound good, by equalizing its frequency response.

We cannot quite agree with that. We will readily admit that such equalization is necessary to make the best of any system installed in such a room. Where we disagree is in whether the "best" in such a context is always worthy of being called even "good!" We readily agree that it will be better than the same room without equalization, but that may not be saying very much! It is not a panacea.

Take the large spherical type of auditorium, or even a large hemispherical one, such as a geodesic dome: this is a natural resonator, with a single dimension in many directions. It must have a response somewhat like a Helmholtz resonator. Sure, that

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MP-8E Mono $86 SP-8E Stereo $137

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DA-6/E	Table top. 1 in/6 out.	$131
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DA-6RS/E	Rack mount. 1 in/6 out stereo or 2 in/12 out mono.	$229
DA-16BR/E	Rack mount. 1 in/8 out stereo or 2 in/16 out mono. Individual output level controls, selectable metering & headphone monitoring.	$287
DA-2080/E	Rack mount main frame with protected power supply, metering & headphone monitor. Will accept up to 10 slide in modules. Each module has 2 inputs & 8 outputs. Individual output level controls & selectable meter switch. Up to 20 in/80 out.	
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RAMKO RESEARCH

Circle 15 on Reader Service Card

can be equalized. But we remember a microphone design, almost 40 years ago now, in which the designer had a brain wave for getting a flat frequency response, in the days when that was a real struggle for microphone designers.

In those days, research on microphones had found that every little cavity had its own resonance or antiresonance. So this designer's brain wave consisted of "cleaning out" the inside, so it had just one big resonance, which occurred at about 1,000 Hertz. The peak was about 30 dB above the level at the ends of the audio spectrum.

So, built right into the microphone's electrical input, was an absorption filter with a 30 dB "hole" at 1,000 Hertz, carefully tailored to have the same width as the microphone's resonance. On the response tracer, using the anechoic room, its frequency response looked beautiful—for those days. It was better than anything else around, at the time.

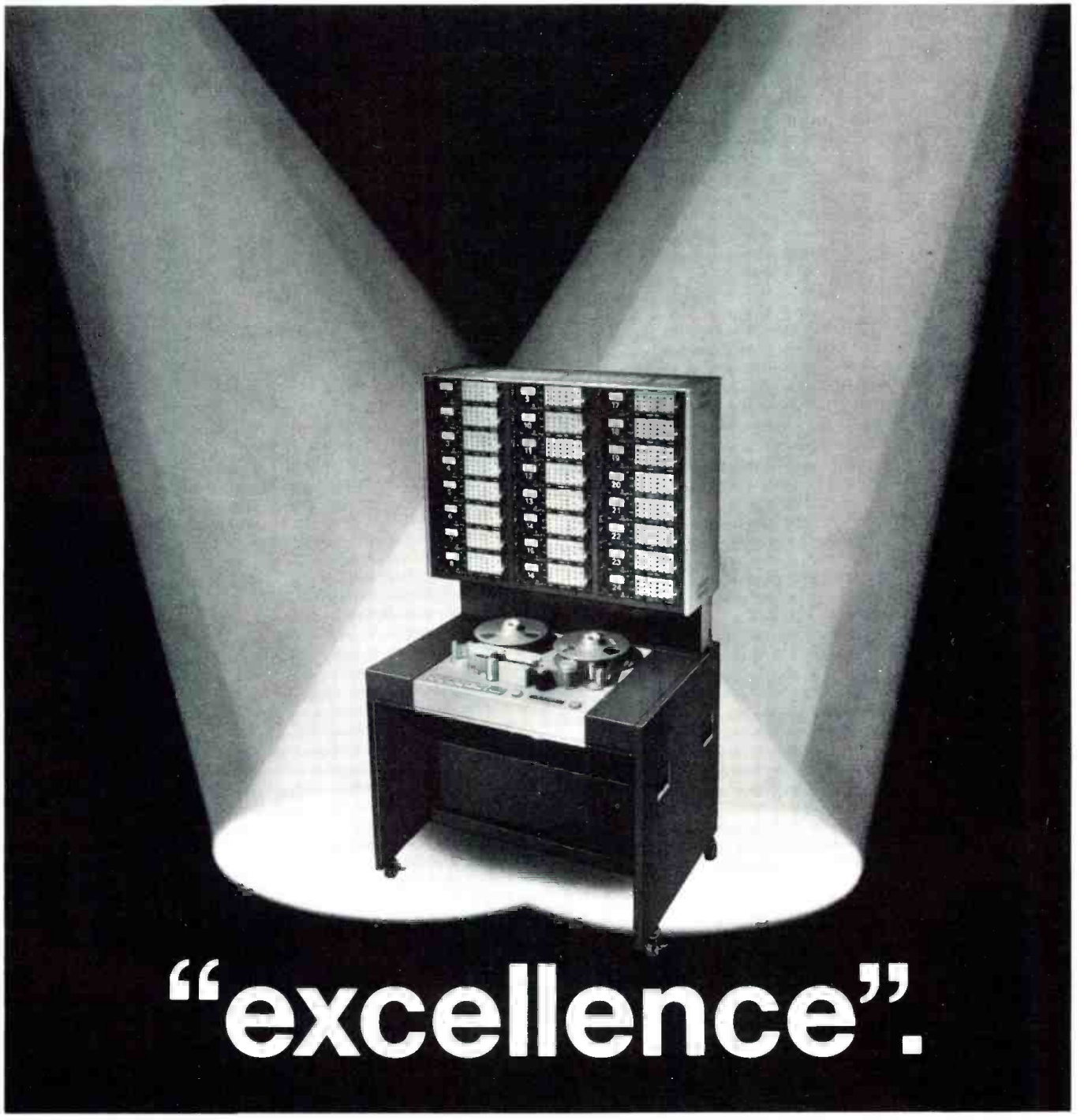
Then came the acid test: using it. How did it sound? Can you guess?

For a 30 dB peak, in the acoustic part, to be damped by a 30 dB dip in the electrical part, would require a coupling efficiency of at least 99.9 percent. Transducers just don't come that efficient. So, although the electrical filter brought the *average* 1,000 Hertz level down to the same as other frequencies, it did not alter the fact that it rang, with a Q of about 1,000!

Of course, few buildings will have that high a Q to their resonance. And anyway, the fundamental frequency will not be that high. But the phony effect will be of the same general kind as that observed there and just less severe.

When we've said and done all, it was rather gratifying, at the BYU workshop where many of these things were discussed, to find that the operator at their large auditorium still uses the same method we devised almost 40 years ago: that of adjusting multiband filters, under the live, operating condition, until the margin below ringing threshold is as close to uniform as possible, throughout the frequency spectrum.

Incidentally, while mentioning that workshop, we understand that plans are going ahead for another one this summer. If this interests you, we suggest you make sure of being on the mailing list, by writing to the Electronic Media Department, Brigham Young University, Provo, Utah. ■



For over twenty-five years the *Studer* name has stood for excellence. Through the years Studer tape recorders have come to be recognized throughout the world as a standard of the broadcasting and recording industries. Studer's A80/VU Recorder was developed for use in recording systems where only the highest quality is acceptable. The great care taken in the design, development and construction of the A80/VU is reflected in its unusual reliability and stability. A superior transport combined with a versatile electronics system and high-precision heads allow studio personnel to work surely. With the recorder a stable, predictable instrument, the energies of the mixer and producer can be applied totally to the creative aspects of their work. For complete information contact . . . WILLI STUDER AMERICA, INC., 3916 Broadway, Buffalo, New York 14227—phone 716 681-5450. (In Canada: WILLI STUDER CANADA, LTD., 416 423-2831)

WILLI
STUDER
AMERICA

Circle 16 on Reader Service Card

db sound with images

MARTIN DICKSTEIN

● Do you recall the heyday of radio (before disc jockies) when one of the most popular features was the dramatic show, in a comic or serious vein? Using only its sense of hearing, the audience was transported anywhere, in any time period, and led through a multitude of plots, now being replayed on television. Much of the realism of the programs was created by a group of people known then as sound effects technicians. These people knew how to create effects that made listeners believe they were eavesdropping on an actual occurence in the location specified in the script. A radio drama could not hold itself together without these special aural effects.

Some of the larger studios of the network stations were specially built with a *live* end and a *dead* end. Acoustically, the live side was made with hard surfaces to reflect sound and was usually used for musical programs, with the instrumentalists arranged there and the studio audience seated in the dead end. Sometimes, the live side had movable or rotating wooden panels which could be set up for the particular liveness desired, with one side of the panel being reflective and the other absorbent. Such a studio might also have been used for dramatic programs when a musical group or instrument, such as the organ or piano, was used for background or as a bridge between one scene and another. Another use for such a studio was as the setting for a comedy show with an orchestra and musical talent, who also appeared as part of the program. Sometimes studios with the best reverberation characteristics were also used for making recordings.

SOUND EFFECTS FOR ILLUSIONS

No matter how much studio characteristics helped create illusions, it was the sound effect which really gave the shows their drama. When the sound had to remain on for any length of time with few variations, the effect was usually pre-recorded on a record which the effects man played on his special turntable. Some record companies specialized in this type of material and had catalogs listing many types of sounds, with variations.

For instance, the background sound of a busy intersection was on a recording of the traffic in Times Square in New York with its intermittent car horns, fire or police sirens, perhaps a police whistle, and a car starting up or stopping as though for a traffic light. You could find a harbor recording, with bell buoys, boat horns, and the lap of water against a dock. A car running at idle, or a speeding car as heard by the occupants, was on a record. So were the sounds of a battle, with sporadic gunfire, shells, machine guns, etc. Trains, boats, large ocean liners, Navy cruisers and destroyers, were all on record. Each record had smaller cuts on the disc for such things as an engine starting up or brake skid or single shots from a cruiser's guns, or for a pistol shot. Single cuts were also ready, with the sound of explosions either above or under the ground, earthquakes, boat whistles of almost every description, train whistles, car horns, and the very brief effects of a train racing by or of a plane taking off or of a dog barking, or . . . .

INGENIOUS LIVE SOUNDS

Although recordings were available for an endless number of situations, some effects had to be made live, by the sound man. One of the simpler ones might have been footsteps on a sidewalk or a wooden floor. These were done, with the called-for speed or rhythm, by the sound man wearing shoes with leather heels. Running up or down stairs was performed by the sound effects engineer on a specially constructed three- or four-step staircase. The speed of ascent or descent was controlled according to the needs or age or sex of the character who was being portrayed in the script.

Sometimes, because of the unique construction of the sound effect turntable, it was possible to play two cuts of one record. The turntable had three tables, with an arm on each in the usual fashion and an additional arm located at the rear of each of the tables. Thus, the sound man could play two effects from one disc, or he could restart at the beginning of a long cut if the effect had to continue beyond the length of the cut itself.

He could even incorporate filtering on the multi-disc console or fades and mixes, but when it came to making a particular sound at a precise moment in the action of the show, this was done live even if the disc had the sound. This would be true of single pistol shots, which were done with a pistol (without real bullets, of course, since realism had to stop somewhere). A body falling was done live by the sound man, not the

actor. "Real" stabs were done with a knife and a head of lettuce, for instance, and an immediate groan from the actor-victim. Horses hooves were achieved, at the proper gait, with either scooped out coconut shell halves or a pair of rubber bathroom plungers. The surface was a sand box filled with a mixture of gravel, a piece of wood, or a piece of slate, depending on the requirements of the program. The "horse" galloped, cantered, trotted, walked or jumped; it made no difference to the sound man, who was possibly on intimate terms with horses and their gaits.

The sound of water lapping against the side of a ship was provided either by a recording of the real thing or done in a square box containing water with a four-bladed paddle suspended in the water from a bracket on top of the box. A handle on the arm of the paddle let the sound man create a lapping with whatever force was needed at the precise moment it was called for. A rainstorm was another matter. Rainstorms on records might not have exactly the type of rain the script demanded, or recorded thunder lacked the desired sharp and brittle effect. Or, perhaps the sound had to be "on mike" or in the immediate presence of the actors (and the audience). Realistic rain was sometimes created with rice or sand on a tin sheet. The effect of lightning was achieved by hitting a tin sheet suspended in a wooden frame. The vibrating tin enhanced the illusion of crackling lightning.

Another effect which was created manually was the sound of fire. Here, the sound man used a piece of cellophane, usually taken from a pack of cigarettes, and crumpled it in his hand, adjacent to the microphone. The harder and faster he crumpled the paper the more fierce the fire.

The sound of a door was the real thing. A wooden frame mounted on wheels, for easy mobility, usually had in it a standard door, complete with door knob and key lock, and a screen door with squeaky spring and handle. A similar frame usually contained a car door, complete with window, handles on both sides, and the locking button. On *Inner Sanctum*, a night-time mystery show, the special sound of a squeaking door at the beginning and end of the program became the signature of the program. This had to be created specially, accomplished with a wooden device in which one piece of wood in the shape of a thick peg was rotated in a hole made in another piece. Tension on the peg was created with a taut strap in order to change the intensity and pitch of the squeak.

JACK BENNY'S MAXWELL

Many more sounds like these were created by the sound effects department for specific needs of scripts, but one that was made aurally was on a comedy show. On the Jack Benny program, the sound of the old car owned by Mr. Benny (a Maxwell with temperament) was made by Mel Blanc, who used his mouth, with heaving and puffing to stall the car, start the engine and have it conk out. The sound came on cue with all the comedy the sound itself could create. It got laughs and applause each time. It became a household word, but not too many listeners, even the regulars, were aware that the name credit for Mel Blanc as an actor on on the show was also for the special sound effect.

One of the other unique effects created for only one special purpose was on the *Fibber McGee and Mollie Show*. A closet was opened by McGee against the better judgment of his wife, who warned him not to do so. The resulting clatter of all sorts of things including what sounded like

pots and pans brought laughter and applause each time. The sound men on the show just dropped items and kicked them around and ended up with a single sound of something falling a beat later and sounding like an afterthought to the whole mess.

Radio had a tremendous effect on the public, who used to spend hours just *listening* and imagining what was going on with the help of sound effects. Only on radio could something like the *Orson Welles Mercury Theater* program of H. G. Welles' "War Of The Worlds" cause such a panic the likes of which we may never see again. Perhaps some of you may remember; maybe you were too young. Today, television, with all its creativity, could never do this, but with the news as bad as it is normally, perhaps it's just as well.

TELEVISION SPECIAL EFFECTS

Television also employs special effects, but the sound effects are actually live, or made to fit the action on the screen. This also requires a good deal of talent, we're not taking that away. The effects used in video that might be of most interest are the visual ones. For example, the backdrops on some newscasts are rear projection of slides or film to fit the story. The *special* effect is the superimposing of the newscaster over the background. You might notice that there is sometimes a slightly visible blue outline to the newscaster like a faint aura all around him (or her). This is a special technique with which the broadcaster is picked up by one camera, aginst a plain background, while the second camera is picking up the screen with the rear projection. The video console operator then performs an operation with a piece of equipment permitting chroma-keying and the person is seen in front of the screen.

SPECIAL EFFECTS GENERATOR

A special effects generator, available on all broadcast video operating consoles, and now even in some of the industrial and educational in-house video systems, allows the technician to cross-wipe from any side, up and down, from any corner, and to insert a second image over another in any spot of the screen desired. Other effects include an opening on another scene from the center to full screen, or the closing to another scene from full screen to a spot in the center. It is also possible to reverse negative and positive images so scenes can be made to look like dreams or the past being brought to mind in the present. Color effects can be used to tint a full image one shade and then switch to any other of the primary video colors (blue, green, red) or any combination. Special typewriters can letter titles on the screen while the video signal from another source is still visible on the screen.

Special effects are being developed every day for particular applications and purposes. Electronics are marvelous, and as engineers in broadcasting and production houses get to learn and know more about the uses and development of circuits and equipment, the effects they will create will be numberless. Television will eat up the special effects as quickly as they can be designed and made, and soon they will cease to boggle the mind of the viewer, and the public will again begin to want more, more, and still more.

Broadcasting has always demanded the most and the best from technically creative people, and they have always been able to come through with something new. Now that we're in the last 25 years of the century, what's next? Pretty soon we'll be in the 21st century, and what's new will be old. Don't just sit there . . . get your thinking caps on!!! ■

NEWS BRIEFS

CD-4 Session in L.A.

At the meeting: David Heneberry, Jac Holzman, Hirohumi Tokumitsu, Howard Yamato, and Tex Takeoka.

Proponents of the CD-4 discrete four-channel sound reproduction process have met in their first plenary session to review recent developments and lay the foundation for further promotions. According to John Eargle, JME Associates and consultant to the CD-4 advocates Matsushita (Panasonic), JVC, Warner Communications (WEA), and RCA, the meeting took full advantage of CD-4 momentum.

A number of multi-media presentations aimed at audio dealers and appropriate for consumer viewing will be launched early this year by a team of CD-4 specialists. The CD-4 team will conduct in-store training sessions for sales personnel, closely tying in the software segment of the industry.

"The idea is to get more knowledgeable salesmen and to broaden software distribution," Eargle said. "This does not mean that the typical audio dealer will stock and sell CD-4 discs, but he will know more about software. The brunt of the software thrust will continue to be through traditional record outlets."

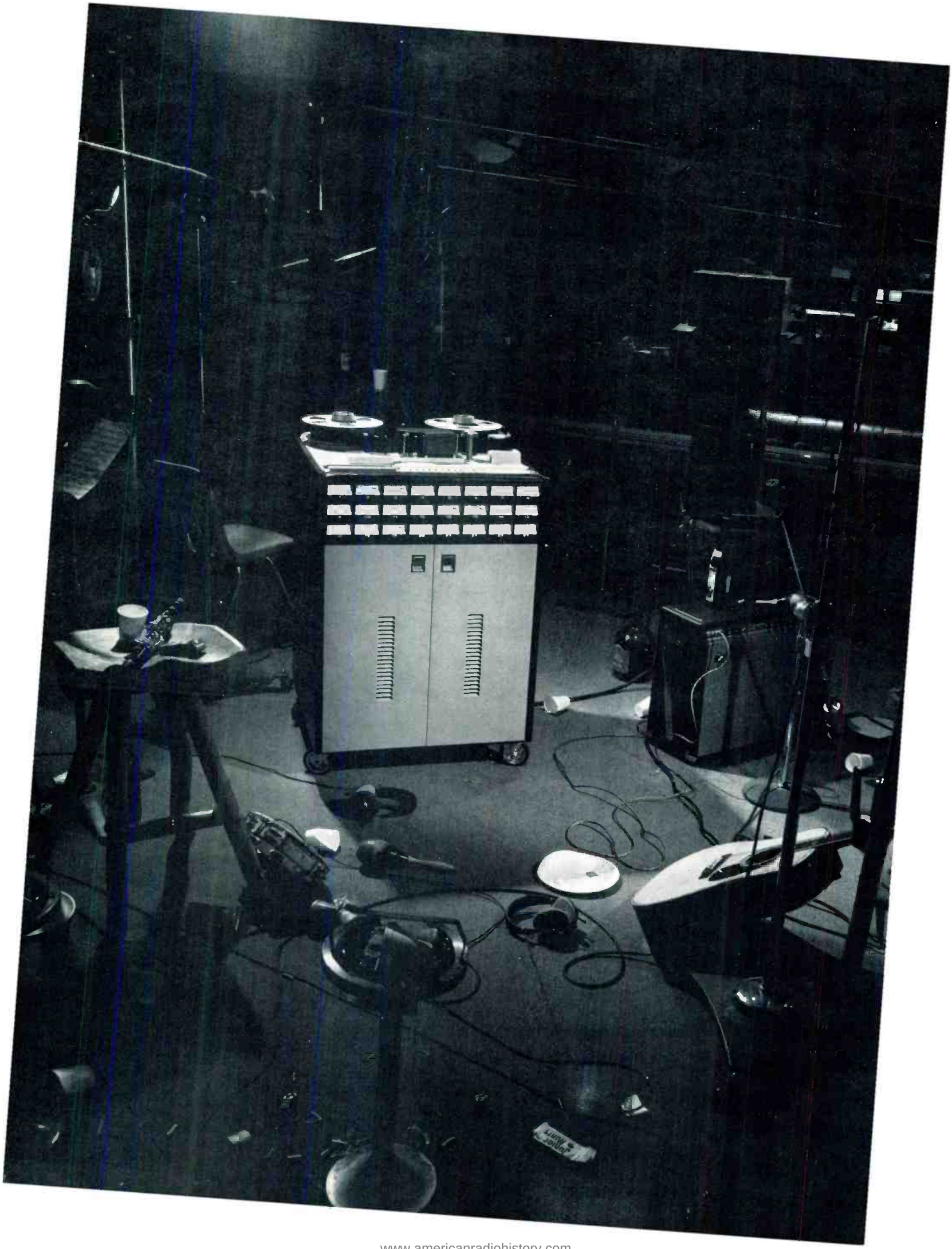
Additional promotion plans call for individual participation of CD-4 sponsors at a number of important trade shows and conceptual presentations at international trade events. A CD-4 handbook is being produced to illustrate the differences of the various CD-4 hardware and includes a software listing.

While quad broadcasts are being evaluated by the NQRC and reports are being submitted to the FCC, the CD-4 proponents are pursuing cable FM technology in transmitting four-channel. Tests are being conducted jointly by Gill Cable TV and Panasonic.

Eargle reported that the session included a review of significant technical progress in CD-4 techniques and a preview of the new Mark III cutting system, to be made available next year. The Mark III will provide low-price cutting capability for independent studios and record labels.

Those attending the plenary session included David Heneberry, v.p., RCA Records; Jac Holzman, senior v.p., Warner Communications and Chairman Quadraphonic Planning Group of the Warner/Elektra/Atlantic Labels; Hirobumi Tokumitsu, executive v.p., Victor Co. of Japan, Ltd.; Tex Takeoka, senior managing director, Matsushita Electric Industrial Company, Ltd. of Japan, and Howard Yamato, executive v.p., Matsushita Electric Corp. of America (Panasonic).

Other participants included Irwin Tarr, M. Yasuda and Adam Yokoi (Panasonic), T. Oguri, Vic Goh and M. Furuta (JVC), Keith Holzman (Elektra Records), John Pudwell (RCA) and John Eargle, (JME Associates). ■



A very rugged tape recorder for a very delicate business

Ampex designed the MM-1100 multi-channel tape recorder with your business in mind. We've been building professional recorders longer than anyone else, and we've learned that producers, engineers, and studio operators have a lot to worry about. So we build the one piece of equipment you can plug in and forget.

Coddle your talent, if you must, but shove around your MM-1100
That's right, shove it around. That's why we put wheels on the MM-1100. Dolly it from studio to studio, or truck it across town. The heavy cast frame and solid steel cabinetwork will keep all the little parts and things where they belong, and the only "installation" routine you'll go through is to plug in the power and input lines.

Pinch your pennies, hoard your dollars, but squander your discrete channels
One MM-1100 can give you 24 tracks. Two of them hooked up together with a synchronizer will give you 46 channels. That's enough to mike your setup for left-and-right running water, if you want it that way. And with all that channel capacity, you can save plenty of channels for sweetening, later additions, and a last-minute background by a hundred voice choir.

Three heads are better than one when you can change them yourself
Ampex makes 24-channel, 16-channel, and 8-channel head assemblies for the MM-1100, and changing them is as easy as turning one thumb screw and swapping units. Touch up the equalization and get on with the session. No need to worry about tape tension adjustments because that's all done automatically by the MM-1100 transport mechanism.

Never enough time, never enough tape. But we handle a 16" reel of two-inch easily
The tape transport in the MM-1100 is a real grizzly bear. It has plenty of control power, even when the reel is a sixteen-incher loaded with 2" tape. And even with all that mass to control, the capstan servo zeroes in on synchronizer commands fast enough to use two MM-1100s in parallel for the 46-channel stuff you always wanted to try.

Your maintenance guy can work banker's hours because our "doctor" makes house calls
Ampex field service sells a lot of equipment for us. We build a fantastic machine, and it almost never develops a problem. If it does, however, you'll appreciate our policy of having service engineers who know both our product and your industry. They're available to keep your group together and working.

The business gives you a headache; Ampex gives you a tape you can sell
Full technical specifications are in our MM-1100 brochure, which we'll be glad to send you free. Working models are in studios all around you, and if you don't have a friend who'll let you inspect his MM-1100, we'll arrange a demonstration. In fact, we'll do anything we can to get you rolling in the multi-track business, if you'll just tell us how we can help.

In a delicate business like production recording, there just isn't any substitute for the Ampex MM-1100—a very rugged tape recorder.

AMPEX

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Circle 36 on Reader Service Card

overkill in the grounding business

● In the October issue, I printed a letter from "Mr. Doe," who was having his troubles with hum. But there wasn't enough information given to locate conclusively the source of his problem. Was it a ground loop? Maybe it was a (signal) wiring problem. Maybe not. I haven't heard from Mr. Doe again, and he left no clues as to his address, so this may be an unresolved problem.

However, I've received a number of solutions from interested readers. which I'd like to pass along for two reasons: 1. Maybe the thoughts contained in these letters will help Mr. Doe (wherever he is), 2. I can't think of anything else to do this month.

"Let this University Professor try to show you that we can have a practical bone in our body. John Doe has a hum problem because of over-kill in the grounding business. Tell him to take out that '8 gauge copper baling wire hooked to a cold water pipe and sunk 7 feet into the ground' and if the hum doesn't go down a noticeable number of dB's, I'll wear my Paul Klipsch yellow B--- S--- button for a week.

"If it does go away, why? Probably because there is a confusion of safety grounds (those 3 wire power plugs), signal grounds, and power line neutral circuits. This can induce currents in signal line shields that cause millivolts of voltage drop across ends. If, through mysterious interconnection, part of the power line neutral current is carried through the microphone shields, the hum could be horrible.

"The most intelligently engineered equipment from a hum control standpoint is the analog computer. These machines work from d.c. to 2kHz and have to be properly shielded and grounded. They use multiple grounding networks for safety, power distribution, signal grounds, etc. All of these grounds have only one common tiepoint and ground loops are avoided like a plague. It works—and Audio can learn a good lesson here.

J. Robert Ashley
Professor, Dept. of
Electrical Engineering
University of Colorado."

Professor Ashley didn't indicate what B--- S---- means. (Some academic term no doubt.) He *did* indicate that grounding is no simple matter. Many studio engineers have given up trying to dope out a confusing grounding system and use the traditional cut/solder technique, which is given here in its entirety. In the presence of an annoying hum:

1. Reach for the nearest ground wire.
2. Cut it.
3. a.) If hum decreases, movc on to the next wire.
   b.) If hum increases, solder it back together again and *then* move on to the next wire.
4. Continue through the entire system until:
   a.) the hum is gone, or,
   b.) you run out of solder, or.
   c.) you are accidently electrocuted.

If Professor Ashley taught such nonsense, he'd probably find all his students wearing their Klipsch B--- S--- buttons. But sometimes it's the only way, especially if you've inherited a studio that had its beginnings in the dim dark days of mono and has "just sorta' growed" ever since. Chances are, there's no one around who really remembers what the last guy did with his grounds, and every addition becomes a 60Hz adventure. Or consider the problems of working in a very old building, where the original electrical service may have been a little on the casual side.

HAPHAZARD GROUNDS

"John Doe's problems ring a familiar bell in my memory. I have been the recording engineer for Town Hall in New York City for 8 years, and in that time I designed and built a rather sophisticated recording system. During the process of building it, I have come across hum problems that the average recording engineer would not encounter in a lifetime. Somehow I have managed to cure them all by one means or another, but the one thing that gave me the biggest headache was very similar to the one described by Mr. Doe. He mentioned that the building he occupies was built in 1919, which makes it almost as old as Town Hall. In those days, electrical wiring practices were not as strictly regulated as they are today, and as a result grounds were always made in a haphazard manner. It was not uncommon that two sections of the same building had two separate ground potentials. With the need of greater power handling capacity, many old buildings were rewired or wires were added to the existing system, making it even more helter-skelter. In my original microphone lines, if any ground touched any structural metal, all hell broke loose—including some nasty shocks of the 100-volt type. My cure for the problem was to rewire the whole mic system, making sure that no ground was anywhere near a building ground. In addition, I floated all of my equipment grounds. True, I used a lot of wire that way and spent countless hours tracing down ground loops, but in the end I had a quiet system. It appears to me that the high level hum that is causing Mr. Doe to become an aspirin addict could be solved in a similar manner. I am not sure if this will also cure his low level oscillating hum, but I guess it's worth a try.

John H. Sadler
Sadler Recording Service
New York City

Of course, we've all heard stories of musicians who have been zapped by coming between a microphone stand and a guitar amplifier when the grounding system wasn't quite right. The p.a. boys have a lot of fun with this sort of thing every time they set up on a strange stage. Often there's no time to double check for danger spots, but it pays to be careful. If you're working in a studio, as Mr. Doe is, hopefully you can eventually cut/solder all these problems away.

LOW LEVEL HUM

As for that low level hum that comes and goes, *". . . this too could be caused by his grounding system. He says that his studio is a 4-track one, which brings to mind Tascam's Model 10. This console, as well as several others, is set up as a high impedance unit. Add-on transformers may be used for low impedance inputs, but since this would lend itself to an easy modification to balanced inputs, which Mr. Doe does not use, I would assume that he is still using High-Z microphones.*

"One problem that I have noticed when setting up an occasional High-Z p.a. system for a church or school is that with any appreciable length of cable between the mic and the system

ground, this will place much of the cable's shield a couple of ohms above ground. This allows a small current consisting of whatever hum or other electrical noise exists nearby to flow in the shield. With a long length of cable, the larger capacitance will easily couple this noise from the shield to the center conductor, where it is fed into the microphone preamps and onto the tape along with the desired audio signal.

"Touching the microphone's case (which is electrically a part of this shield) will increase the amplitude of the hum, since the body presents a larger 'antenna' to pick up the noise. This also happens, to a lesser extent, when one's body is moved close to the microphone. This may sound far-fetched, but the next time you encounter such a symptom, notice whether or not the hum seems to keep in tempo with the music. Then look out through that glass window. There's probably someone swaying back and forth in front of a mic.

Ken W. English
A.I.M.D. Work Center
NAS, Patuxent River, Md.)

Do you suppose Mr. Doe *is* running high impedance lines? I'd guess that since he is apparently in business with a few engineers on staff, he has at least a semi-pro operation, which would suggest low impedance microphones. On the other hand, he did mention unbalanced lines, so maybe...

Where the hell are you, Mr. Doe?

I don't know if any of this is helping you, but maybe it will serve to remind others that grounding is not to be taken lightly.

Professor Ashley's reference to computer techniques is particularly relevant. I've just come across a book called *Grounding and Shielding Techniques in Instrumentation*, which I will try to read and include in the next book review column, due in a month or two. In the meantime, watch those grounds!

• • • •

P.S. ON THE LONDON TRIP

Since this is being written so far in advance of publication, it's difficult to say for sure if there is any more room on the package trip to the A.E.S. Convention (March 1-9). However, if you're reading this in late January or early February and want to come along, see the December '74 issue for details, and contact the Mirque Travel, 350 Fifth Avenue, New York, N.Y. 10001 *NOW!* Or call 212 PE 6-6338 for last minute information. ■

Goodbye old paint. Hello Oak.

Goodbye leader. Hello new generation.

Our new generation 604-8G has inherited quite a kingdom from the leader. We changed the 604 after 20 years as the standard monitoring reference source. We added a new dividing network that smooths the response in the crossover region, changed the frame and improved the high frequency diaphragm (it's now up 6dB at 15 kHz).

But the 604 is still the 604. The same duplex speaker delivering sparkling highs, clean midrange and exceptional low frequency transient accuracy from a single point source.

Then we developed the new 620A cabinet for the 604 speaker. The 620A replaced our painted old classic 612. Recording studios were spending thousands of dollars to sound and look beautiful. So we made the 620 enclosure beautiful on the outside. In rift-out oak. Add the 604-8G, and it sounds beautiful. In fact, the new combination delivers another full octave of usable low bass to help meet the requirements of the new generation of music. And it's loud, louder, loudest — even after a full recording day.

The 604-8G and the 620A. Together they make beautiful music.

If you want more information write us or call (714) 774-2900.

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ALTEC

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Circle 18 on Reader Service Card

db new products&services

FUNCTION GENERATOR DUO

● Two generators in one package provide sine, square, triangle, pulse and ramps, as well as internal sweep, trigger, gate, or burst, the combination designated as model 3312A. The main generator covers 0.1 Hz to 13 mHz in eight ranges, and the modulator generator delivers signals from 0.01 Hz to 10 kHz. The main generator can be triggered or modulated by the modulation generator to provide sweep, a.m., f.m., or tone bursts. Output of the main generator is 10 volts peak-to-peak into 50 ohms for all waveforms with variable control provided by a four-position attenuator. Dial accuracy is ±5 percent of full scale, sine wave flatness within ± (maximum output amplitude) from 10 Hz to 100 kHz and better than ± 10 percent from 100 kHz to 10 mHz. For triangular waveforms, deviation from the best straight line at 100 Hz is less than 1 percent. Using the voltage-controlled oscillator input for external frequency control, a sweep range of 1,000 to 1 can be obtained.
Mfr: Hewlett-Packard
Price: $900.
Circle 40 on Reader Service Card

DIGITAL DELAY LINE

● A plug-in card based system is featured by model C200 digital delay line. The complete unit is determined by selection of these modules, which come in five basic categories: INPUT, TIMING, DELAY, OUTPUT, and SPECIAL. One of each input and timing modules is required and some combination of delay and output, selected as required. The special module is used for interfacing and special analog processing. Delay characteristics are selectable in 7.5 millisecond steps from a minimum of 7.5 ms to a maximum of one output at 907.5 ms. per frame. Greater delay can be achieved by adding additional frames and interface modules. For use in live performances, a microphone mixing module is available, which can preamplify two or four low impedance mics, mix the signals, and apply them to the delay chain.
Mfr: Eventide Clockworks, Inc.
Price: $1,023.00 and up, depending on configuration.
Circle 42 on Reader Service Card

PRINTED CIRCUIT AMPLIFIERS

● Three new printed circuit amplifiers utilize the MAP 1731A audio operational amplifier, from the same manufacturer, as their active elements. The amplifiers are all designed for p.c. card rack or individual mounting. Model AM-27 is a general purpose audio module suitable for low level microphone preamplification. Model ABL-27, with transformer coupled input and output, is designed for amplification of medium to high level (+20 dB) signals or wherever it is necessary to bridge a floating or balanced source. It has an adjustable gain from −7 dB to +33 dB. Model AL-27A is a multi-purpose audio amplification module used in line, booster, differential, or combining amplifier configurations. It has transformer coupled output, adjustable gain/loss up to +47 dB and low noise of −125 dBm.
Mfr: Modular Audio Products
Circle 43 on Reader Service Card

PRODUCTION CONSOLES

● Modular consoles TV 32 are multiproduct (up to 32) by 4 submaster, t.v. studio and production center units. They contain 20 low-level inputs or 104 high level sources; 4 submaster busses with selection to 2 master busses; echo send on all inputs and submaster; echo return on all submasters and masters; elective group mic muting. 14-band reciprocal equalizers are available on all inputs, as well as cue and selective foldback.
Mfr: Audio Designs
Circle 44 on Reader Service Card

SINGLE-CHANNEL COMPRESSOR/LIMITERS

● Model 160, a pair of single-channel compressor/limiters is continuously variable from 1:1 to infinite compression, with a limiting threshold variable from 10 mV to 3 V rms with a pair of leds to indicate whether the device is operating below or above threshold. The illuminated meter has −40 to +20 dB range with adjustable zero reference and is switchable to read input level, output level or gain change functions. A gain control has a range of −20 to +20 dB. The unit has balanced bridging and 100Ω output with Jones barrier strip terminations and operates at line levels up to +24 dBm in and out. Output is balanced and ground loop compensated. There is a built-in circuit to suppress turn-on and turn-off transients. The manufacturer also offers a simpler model, 161.

Mfr: dbx, Inc.

Price: Model 160: $300.00.
Model 161: $250.00.

Circle 45 on Reader Service Card

PUBLIC ADDRESS STANDBY

● Emergency a.c. power can be wired into a utility system, powered by solid state generators, known as the SSG system. The system will go into effect 50 milliseconds after utility failure. In large areas, the system can be zoned under separate zone distribution panels connected to the electrical distribution boxes in that area. Available in single, two, and three phase models, in sizes (SS) 200 to 700 watts and (LS) to 10 kW in single phase and up to 30 kW in three phase. SSGs provide 120 volts or 277 volt, 60 Hz power for 1½ hours plus after power failure. Self-checking, the system is controlled by computer logic.

Mfr: Standby Systems, Inc.

Circle 46 on Reader Service Card

PORTABLE DUAL CHANNEL P.A. SYSTEM

● Convenient in situations where voice amplification is desirable, SS-22 is wireless and portable. Weighing 16 pounds, it runs on standard D-cell batteries or an 110 volt a.c. line and features high fidelity sound quality. Two microphone versions are available, lavalier clip-on or hand held; the microphones have a transmitting range of 100 to 300 feet with a crystal control system. These can be used singly, simultaneously, or in combination with a wired microphone. Applications include function as a complete sound system, a wireless tuner for already existing public address systems, or as an amplifier/speaker for tape or record players.

Mfr: Edcor

Circle 47 on Reader Service Card

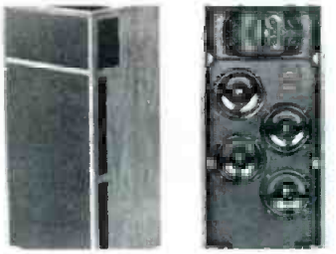
COMPACT STUDIO MONITOR SPEAKER

• Designed for applications requiring extended frequency response, low distortion, and wide dynamic range, model 9849A offers this in a small space. The 12-inch bass loudspeaker produces low-frequency response with low distortion, even at high power levels. The dividing network includes an r-c section circuit in parallel with the low-frequency load to stabilize the input impedance of the network at 8 ohms. Frequencies above 1500 Hz are handled by a compression driver mounted on a sectoral high-frequency horn, located close to the low-frequency section. The braced enclosure measures 24 x 20½ x 15¼ inches, made from ¾ inch material.
Mfr: Altec
Circle 48 on Reader Service Card

DIGITAL MULTIMETER

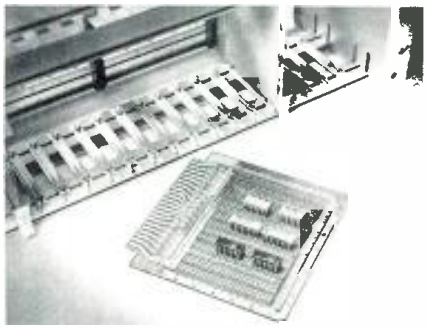
• A palm-sized hand-held digital millimeter, model 21, measures capacitance along with a.c. volts, d.c. volts, and resistance. The instrument has four d.c. voltage ranges with 1 mV resolution; four a.c. voltage ranges with 1 mV resolution; four resistance ranges with 1 ohm resolution; four capacitance ranges with 1 pFd resolution. It has l.e.d. displayed 3½ digit readout (up to 2,000 counts) and simplified five step calibration. Model 21 operates from four rechargeable NiCad batteries.
Mfr: Data Technology Corp.
Price: $269.
Circle 49 on Reader Service Card

MONITOR LOUDSPEAKER



• Intended for monitoring application, high-fidelity loudspeaker Monitor-C employs four eight-inch wide range speakers to provide bass and mid-range tones and eight treble speakers. The bass/mid-range speakers are designed with rigid aluminum cones, intended to prevent "breakup" within the cone and light enough to provide good transient response. The eight tweeters are arranged in a sector-of-sphere configuration; tweeter cones are aluminum. (A characteristic of aluminum is that it is non-hygroscopic, resistant to humidity factors.) Frequency response is 30-to-20,000 hertz. The unit has power handling capacity for 150 watts program power; its nominal impedance is eight ohms. Crossover between bass/mid-range and treble speakers is at 2,000 hertz at a rate of six dB an octave.
Mfr: Bozak, Inc.
Circle 50 on Reader Service Card

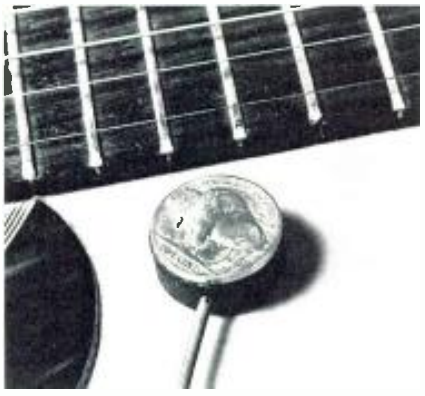
SMALL PLUGBOARD/CAGE



• Economically sized cards, 4.5 inches by 4.5 inches by 1/16 inch, are supported by model CCK13A adjustable cage. 19 inches wide. Six board types provide ground planes, power bus paths, and interconnection pads. Five boards have 0.1 inch spaced 0.042 inch diameter hole patterns to accommodate DIPs; the sixth board has 0.062 inch diameter holes on alternate 0.1 inch centers for discrete components. Contacts are made of epoxy glass. All boards have holes for ejectors. The cage accommodates up to 21 cards, using aluminum card guides.

Mfr: Vector Electronic Co.
Price: Cards: $5.20-$11.65 ea.
Cage: $33.45
Circle 53 on Reader Service Card

CONTACT INSTRUMENT PICKUP



• The tiny P800 Buffalo pickup, with a Buffalo nickel as a lid, operates on an electret condenser principle and attaches to an instrument with removable adhesive tabs. It has its own power supply, which can be attached to the performer's belt or clipped to a mic stand. Power for the unit's preamp comes from a 9-volt transistor radio type of battery. It's equipped with a standard phone jack. Model P800Z features balanced output and an XLR-3 connector.

Mfr: Group 128
Price: Model P800: $99.50
Model P800Z: $119.50
Circle 54 on Reader Service Card

CASSETTE TAPES

• A choice of two tape formulations, ferrocrystal or chromium-dioxide are offered in this new line of cassette tapes. The ferrocrystal tapes, designated EX, claim improved frequency response, good s/n ratio, enhanced dynamic range and a special binder material to insure even particle distribution. The manufacturer claims that the chromium-dioxide tapes exhibit superiority to iron oxide in frequency response, s/n ratio and extended high frequency output. The tapes are available in C-60 and C-90 lengths.

Mfr: Nakamichi Research
Price: EX: $3.69 & $4.79
Chrome: $4.59 & $5.99
Circle 55 on Reader Service Card

PRODUCT GENERATOR

• Outboard product generator type PG-3 makes it possible to generate the product of two incoming signals, and can achieve tremolo effects, tone modulation, triggered expansion and VCA applications for synthesizers. Integrated circuit technology includes laser trimming and computer aided design. Contained in a standard 3½ x 19 inch rack mounted chassis, the unit has a color-coded front panel.

Mfr: Wattnott Electronics
Circle 56 on Reader Service Card

MILFORD K. SMITH

For Better Broadcast Audio Processing

Station WPGC improved its listening "image" by acquiring some new equipment, experimenting, and modifying. Result: an easily identifiable and more distinct sound.

BROADCAST AUDIO PROCESSING is probably one of the most popular topics of discussion among broadcasters, audiophiles, and hopefully, record producers who care what their final product sounds like when presented to the public en masse via radio. This topic is also easily one of the most misunderstood by many of those mentioned above. Our purpose here is to dispel a few of the myths, point out some of the problems, and hopefully, come up with a few useful solutions.

Many of the techniques discussed herein are currently being employed at WPGC AM and FM in Washington, D.C., where I am chief engineer. WPGC is a 10-kw AM, 50-kw FM stereo operation, which ranks as the number one contemporary station in the nation's capital, and consistently shows up as the overall number one or two station in the market. As such, it typifies the "average" large contemporary station on the air today. Many of the techniques to be described will be of interest to stations of all sizes and formats, but some may be prohibitive to many small facilities, merely from a cost standpoint.

TYPICAL STATION PROBLEMS

Upon my arrival at WPGC, the station was confronted with several problems which will sound familiar to any radio chief who has been part of a competitive top-40 effort. First and foremost, and closest to the heart of any top-40 sales manager or station manager, the station didn't sound loud enough on the air. The complaint was that in car radio pushbutton comparisons, the other contemporary stations in the market sounded louder than we did. One may say, "So what, turn up the volume."

But the top-40 listener is an elusive individual. He tends to jump from station to station in search of the music he likes best. If you can somehow make your station easier to find, it only follows that this dial-spinning person is more likely to find you. Moreover, the psychological impact of tuning in your station and having the music nearly jump out of the radio, is—as strange as it may sound to some not weaned on top-40—not to be dismissed.

In addition to these two somewhat subjective reasons, there are several solid technically defensible ones. First, the level of man-made electrical noise (EMI, QRM, or what have you) throughout your coverage area is constantly increasing. This means that the signal-to-noise ratio is decreasing. In other words, the listener has to try harder to drag you out of the soup. By increasing, and then consistently maintaining, a very high on-air level of modulation and "loudness," you are adding a few critical dB to the diminishing s/n ratio, frequently enough to make the difference between being heard and not being heard.

Considering, for example, a typical signal-to-noise ratio of 9-12 dB present in a city-traffic automobile, this several dB improvement becomes very important. Secondly, some parts of your program material, due to frequency distribution, pre-station processing, etc., may be transmitted at audibly different levels of loudness, although the old vu meter and perhaps even the modulation monitor would hardly give a clue. That leads to a need for continual listener knob-twiddling from program source to program source, and leads eventually to the much fabled, but very real, tune out.

POWER AND LOUDNESS MYTH

Most stations employ at least a minimal audio processing system. Many times this is primarily to avoid overmodulation and resulting citations, but even the simplest system can be optimized to provide the facility with at least some audible benefit.

To start with, let's dispel one popular myth, and this applies to AM and FM stations, although our discussion to this point has centered on AM. Myth: The more powerful your station, the louder it will sound on the air. Not true. For quite some time now, all receivers, both AM and FM, have been equipped with circuits which tend to minimize differences in rf input levels to the sets. In AM receivers they are normally referred to as avc (automatic volume control) circuits, while in FM they are pegged as agc (automatic gain control) circuits.

Provided your station's field intensity over your cov-

Milford K. Smith, Jr. is Chief Engineer at WPGC AM & FM, Washington, D.C.

Disc jockey Jim Collins, who is in charge of the 2-6 p.m. program, is at work in the main control room. In front of him are six stereo cartridge decks used exclusively for all on-air material.

erage area is sufficient (on AM usually 1 mv/m or better; on FM, 50 μv/m for home receivers, 100 μv/m for auto receivers) to fall within the range of these circuits, presto! you are on nearly equal footing with the 50 kw competition, over what we will call your "adequate" service area. Obviously, non linearity in some inexpensive receivers' avc or agc sections may provide some exceptions to the above, but not as much as might first be believed. This, of course, does not mean the "adequate" service area of your kilowatt is ever going to be equal to the 50, but if it covers enough of the market survey area to pull sufficient numbers in the various ratings, the programming department will at least have an adequate tool.

USING AMPLIFIERS AND LIMITERS

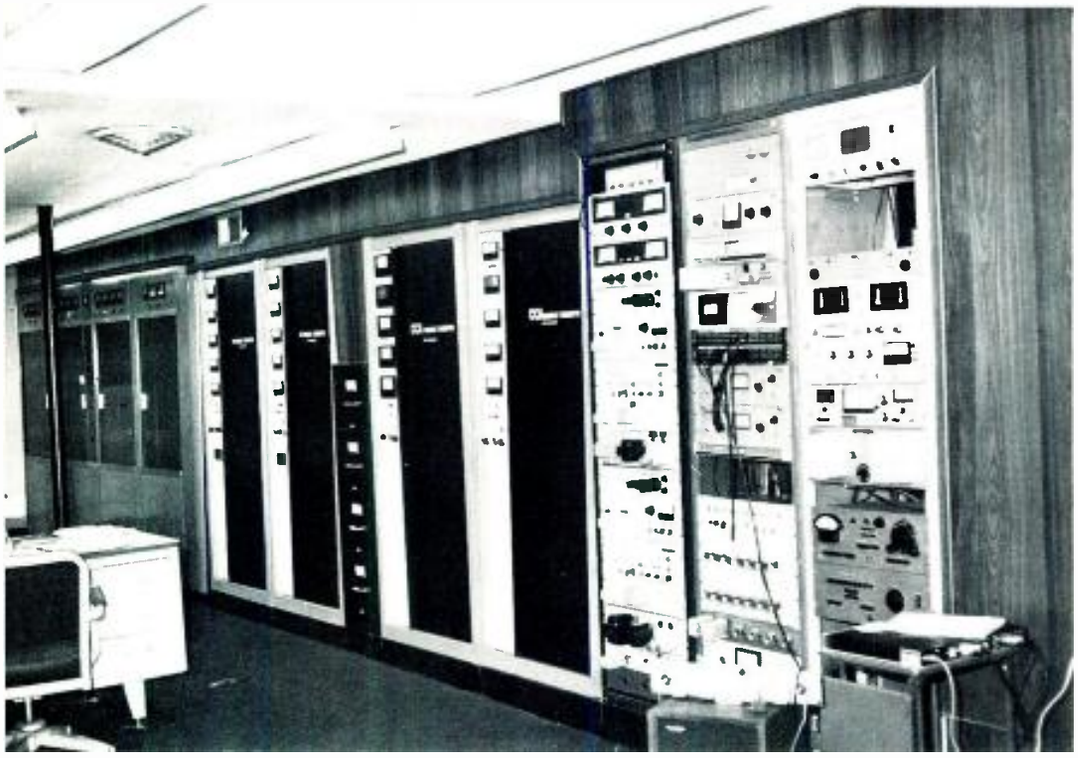
Okay, you suddenly have a better signal than you thought. Now what? Nearly every station has at least some sort of peak limiting amplifier and most have an agc amplifier to stick between the console and the limiter. Already some problems begin to develop. Many stations are using their limiters as agc amplifiers and some their agc amps as limiters.

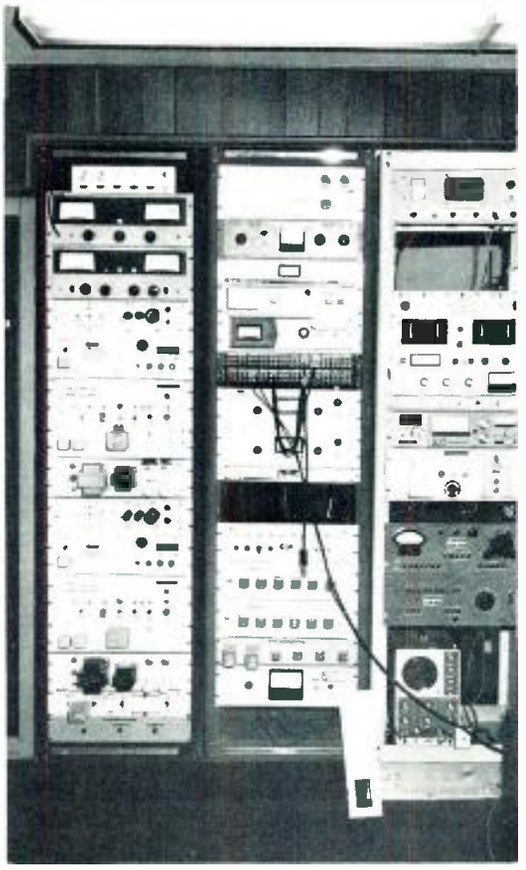
Briefly, an agc amplifier (such as the CBS Audimax, probably one of the most popular units in use today) is a gain-riding device which is designed to follow and control *average* program levels. A limiter is meant to control *peak* program levels. If your agc amplifier is not providing enough control for your particular programming, (i.e., it isn't responding fast enough to level changes or, conversely, is responding too fast) don't use the limiter to compensate. Far too many rock stations let their limiter provide 5-15 dB (or more) of very rapid agc action, which although very desirable in this format, should not be done with the limiter. It causes the limiter to operate off the optimum portion of its curve, and when an actual peak does occur, provided it gets caught at all, it's instant distortion.

Most agc amps, including the latest CBS series, have adjustable controls for rapidity of agc action. These should be carefully set to achieve the desired agc action, consistent with the demands of the program material and the wishes of the programming department. Don't regard the instruction book as god. Your own ears are the best tool you've got. In a top-40 situation, the Audimax alone may very well not provide the degree of compression desired. Don't try to make up for this by pegging the Audimax (or whatever) at the end of the scale. Get another specialized compression amplifier to follow the Audimax, and provide the amount of gain reduction you deem necessary.

WHAT SOME STATIONS DO

At the opposite end of the scale are the stations which seem to feel that the agc amp should be used like a limiter. These are primarily easy-listening or good-music stations who seem to adjust the agc amp so it barely comes off the right hand peg on the highest portions of the program material. Running an agc amp on this end of its control curve is nearly as bad as the converse. These units tend to be optimized both so far as s/n and distortion to work in the mid-portion of their curve; in addition, the gated units (Audimax) will perform their proper func-





Wall panels showing two f.m. transmitters, exciters, stereo generators, and monitoring equipment at WPGC. At right is a front view of the section that has three racks holding monitoring and audio-processing equipment.

tion, as far as nonpumping and return to zero gain is concerned, only when operated within the intended portion of their curve.

Again, the key here is knowing the unit thoroughly. A station of this type may well want slow age action, which can and should be selected with the switches provided, or in earlier units by means of circuit component changes detailed, rather than by backing off input level. In the case of a classical station, of the purist variety, no agc amplifier at all may be a wise choice, especially with the idea of preserving total dynamic range on FM, although many times the dynamic range of the program material may exceed that of the transmission medium.

On AM, though, even with a classical format, it seems that some agc action is a necessity. A complete guide to agc amplifiers and their individual applications, insofar as formats are concerned, is beyond the scope of this article. With the strides being made in audio processing during the past decade or so, it is always wise to keep abreast of what's in the market place, that knowledge may do your facility much good.

USE OF AUDIO LIMITERS

The second major audio-processing item used by nearly every station is the audiolimiter. Let's first consider limiters for AM. Again, the limiter is a peak-control device. It may, depending upon the manufacturer, be able to provide a small amount of rapid agc action, but that is not its primary purpose. There are roughly 50 limiters now available to the broadcaster. The CBS Volumax is very widely used. Most feel that it is a good all-round unit. Unlike the typical recording limiter, there are a number of specialized things going on in the state-of-the-art broadcast limiter. Nearly all of them are vital to producing a good on-air product. The first of these features is switch-selectable assymetrical modulation.

Until recently, the FCC placed no limit on the amplitude of positive modulation of an AM signal. Although this loophole has existed for decades, it was only during the last decade or so, with the increasing interest in broadcast audio in general, that it was widely exploited. I personally, have redesigned transmitter modulators to provide over 200 percent *consistent* positive peak modulation, with an increase in on-air modulation level that must be heard to be appreciated.

Unfortunately, to achieve this degree of super modulation, there are numerous other considerations which must be met to provide a clean signal, free of distortion. Nearly everyone wanted the super modulation, few wanted to do it right. As a result, transmitters with marginal modulators were badly overdriven, additional interference was created, and the Commission acted. Super modulation today sets a limit of 125 percent on positive peak modulation (the limit on negative peaks remains at 100 percent), a two dB asymmetry allowance between the peaks of different polarity.

During the heyday of super modulation, at least two limiters were brought out to aid very much in the transmission of greatly asymmetric program material. Both had peak polarity-sensing circuits to sense automatically the peak with the greatest excursion and, if it was not going positive, flip the limiter's polarity temporarily and make it positive. In addition, both had switch-selectable functions allowing asymmetrical limiting and clipping. These units, while causing smoke to pour out of transmitters when utilized in an "unlimited" positive peak situation, do not, in my experience, provide maximum modulation under the current regulations. In addition, their peak-phasing circuits are nearly useless on well limited recorded material such as found on most contemporary discs today. Thus, they do provide an asymmetric output on voice or other asymmetric material, but a minimum of 70 per cent

of our program material is well limited top-40 music, and thus there is no benefit.

WE EXPERIMENTED, MODIFIED

All is not lost, however. These are all still excellent limiters. And, except in a highly competitive situation, the maintenance of continually asymmetric modulation is not a necessity. At WPGC, we found ourselves in such a situation. After experimenting with a number of limiters, we finally settled on a unit of somewhat older design with a limiting section similar to the newer units (1-2 millisecond attack time) and a clipper section which was originally switch-selectable for negative only or symmetrical clipping. The unit was modified to provide for a continuously adjustable desensitizing of the positive clipping rectifier. In addition, the unit was already equipped with a continuously adjustable clipping level control. In other words, we had a continuously adjustable ratio of rms to peak limiting and a continuously adjustable ratio of positive to negative peak limiting.

The unit, with this modification, consistently outperforms competitive units. The only trade-off has been a slight increase in harmonic distortion, which is still less than the 1.5 per cent or so distortion in the 10-kw modulator. With the poorly designed audio sections in most AM receivers today, the difference is not only inaudible, but unmeasurable. UREI has now introduced this unit as their model BL-40. We have one in use here at WPGC and this unit allows a station to maintain continuous asymmetrical modulation without resorting to clipping circuits.

FM LIMITING DIFFERENT

Limiting on FM must be treated somewhat differently compared with AM. There is no place in FM broadcasting for brutal limiting action. That simply isn't necessary to achieve the desired results.

In FM, though, we have a problem not encountered in AM, that of the 75 μ/sec. pre-emphasis curve. Any strictly linear limiting action will do very little towards controlling the high-frequency peaks which can overmodulate the carrier by 300 percent or more when modulating 100 percent at low and midfrequencies. The CBS Volumax FM limiter, as well as a number of competitive units, compensates for this by passing the flat line-level audio through various stages which compensate for the 75 μ/sec. pre-emphasis by altering the frequency content of the program material at an inverse rate of the slope of pre-emphasis curve.

That, of course, involves some trade-offs in loss of program brilliance, depending on the extent of limiting action, but seems to be the best compromise at the moment. The most recent CBS units (4110 series) utilize frequency selective limiting on the low, mid-high and high frequencies, and achieve as uncolored a limiting action as would seem possible in light of the problem. Perhaps a better solution would be to adopt the Dolby proposal, allowing a relaxation of the pre-emphasis curve to 25 μ/sec. pre-emphasis due to the high-frequency boost of the Dolby.

CHOOSE MODERATION

Again, the word on FM limiting is moderation. Overdriving an older Volumax will severely deaden the high-frequency program content. Your listeners will not tolerate this to the very great degree that it is often done. Our experience at WPGC shows that overdriving the new Volumax will cause the upper highs to increase in amplitude as referenced to the lower frequencies. The message is clear.

At WPGC, we desired to obtain a small amount of additional compression on the FM side, and also a small amount of upper high-frequency peak reduction, over and above that provided by the Volumax. With our type of program material, a slight reduction of the over-10-kHz component has practically no effect on the musical content of the program, and has considerable benefit in allowing us to run a much higher level of modulation without having the average level held down by high-frequency, short-duration peaks.

We chose the Teletronics LA-2 for this chore. The unit provides some of the smoothest compression available by virtue of its optical/electrical limiting system. Additionally, it provides adjustment so that it is more sensitive to high frequencies than low, thus providing the desired high-frequency control and compression. This, too, gets us away from the utilization of any fixed high roll-off filters which are obviously not amplitude selective and do considerably more damage to the program material.

THE PHASE-SHIFT PROBLEM

One additional note on FM limiters. That is the phase-shift problem often encountered in FM stereo installations which precludes meeting the 40-dB (minimum) stereo crosstalk figure (this is L+R into L−R crosstalk and vice versa, not left-right separation). It is nearly always desirable to take the pre-emphasis networks out of each channel of the stereo generator and remove the de-emphasis networks from the output circuits of the Volumax, or other final limiting amplifiers.

That, and a helpful telephone company which is able to give you two equal length, equal gage circuits, will normally enable you to control system phase to within 1 percent, the necessary tolerance to meet the aforementioned minimums. While that is not an FCC required specification, it is vitally important in the transmission of realistic FM stereo programming. Needless to say, proper stereo generator adjustment, transmitter tuning, and antenna VSWR are also important but beyond the scope of this article.

To this point we have dealt primarily with the basics of broadcast audio processing—the factors that will help you deliver a good, clean, full, optimum modulated signal. Many stations seek no more than this from their processing chain; some seek considerably more, and this is where the disputes start.

There are two theories on this matter. One holds that the transmission medium should be an uncolored pipeline from disc to listener. The other feels that the program material can be considerably enhanced through various techniques, and prove a more attractive and better sounding product for the listener.

A DISTINCT ON-AIR AUDIO SIGNAL

At WPGC we were out to create a very distinct sounding on-air audio signal. We wanted to tailor this audio to complement the mean quality of the listening systems in use and to provide the station with an on-air identity so that when tuned to WPGC there would be no doubt in the listener's mind. We also wanted to preserve to the greatest possible extent the transmission quality of which the medium was capable and to provide by programming a general similarity of sound between the AM and FM facilities (simulcast).

Of the many contemporary stations in the D.C. area, not one was using an on-air reverb of any sort. That seemed to be a good starting point. We were determined *not* to end up with the Grand Canyon type of reverb so prevalent in the past and unacceptable today. After careful evaluation we selected what, at the time, appeared to be the best reverb unit available, the EMT 140TS, a unit with which most of our recording industry readers are undoubtedly very familiar. This unit was equipped with a custom-designed control center and was added to both FM and AM program. Since this was a true stereo reverb, we received numerous calls immediately after installation commenting on the "improved stereo" (this, in spite of a 40-dB plus channel separation before the installation). It did not sound canyon-like, listeners said, and it added a nice fullness to the announcers' voices. Somewhat more reverb was added to the AM side than the FM, but this, too, was not of the '60s style and was most welcome. Due to the various phase relationships occurring in the reverb unit, a considerable amount of L−R material was generated even by a totally L+R (mono) system input. That, too, added to the total stereo promotion push.

TURNTABLES AND SOURCE NOISE

In FM, perhaps nothing is so annoying as bad turntable performance. Very likely, most of the stations currently are operating with sub-par turntables. We did not skimp in this department. We purchased EMT-930 stereo tables and from the day of installation, any complaints of rumble or flutter have stopped. We have taken the liberty of running these tables several rpm's fast to provide a faster on-air presentation of the music. Once a listener has heard a record on WPGC, it appears to "drag" on other stations. I would heartily *not* recommend this for any but a competitive top-40 operation!

Another major problem in top-40 FM, is that of source noise. Record scratch, cart machine hiss, hum, even line noise, on our rather lengthy telco circuits can be very intrusive and annoying to the listener. After having initially tested the Burwen Model 1000 noise filter in New York City, I was already sold on this amplitude/frequency sensitive noise suppressor. It performs magnificently, and increases your apparent s/n ratio by 8-10 dB just by inserting it in the line. I heartily recommend that any FM station interested in good sound try this unit.

OTHER IMPROVEMENTS

Most recently, we have added a Garron Phase Enhancer to the FM program and the AM mix to compensate for any phase error in the stereo carts utilized for over half of the program material. The adjustable Marathon carts we use provide excellent phase stability, but occasionally a slightly out-of-phase cart will show up. This unit also maximizes the FM L+R, making for optimum mono listening.

In an effort to compensate somewhat for the poor quality of the average AM radio, we added a CBS dynamic presence equalizer and a Fairchild Dynalizer. The presence equalizer provides an adjustable dynamic mid and upper-mid frequency boost that gives all program material a nice sock in the presence range and corrects for any muddy on-air material. The Dynalizer is used sparingly to extend the high end slightly higher (+5 dB up from 1 kc at 10 kc) and also to reinforce the ever important low end (about +4 dB at 100 Hz.). This action too, is dynamic if the program material already contains what we consider to be adequate compensation. There is no action from either of the two mentioned units. We come off as a very bright, full sounding AM station. Other AM programs come off sounding somewhat muddy and indistinct in comparison.

This then, is audio processing at WPGC. Hopefully, a few of the ideas here may prove useful to you, others may leave you shaking your head, and, that is as it should be. Audio processing at a broadcast facility is an attempted solution to many problems and individual wishes. It should be as unique as the station. These are some of the solutions we have found. Good luck with your own! ■

An overall view of the production area.

db Visits— Robins-Fairchild

From poor relation in the back of a camera company to one of the audio industry's most prestigious names, Fairchild Sound is synonymous with the history of the audio industry.

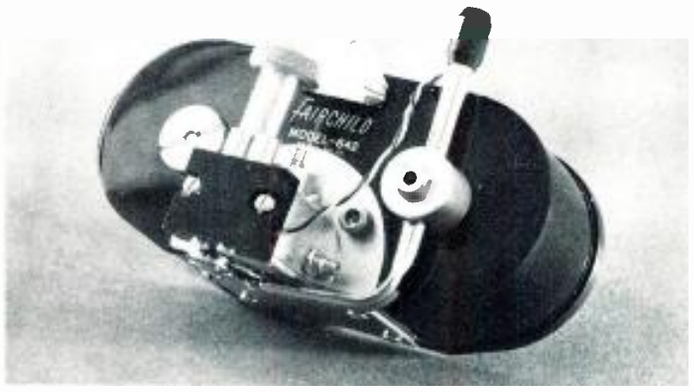
GLENN D. ROGERS

OPERATING FROM an ultra-modern plant in an industrial park in Commack, N.Y. just a bit east of the **db** offices on Long Island, Fairchild Sound Equipment Corp. maintains a *position* of leadership in technological development that extends back to the earliest days of the audio industry in the 1930's. The firm merged with Robins Industries in 1971 after the death of the founder, Sherman Fairchild. The merger has proven to be a fruitful one for both companies, dovetailing Robins' consumer production know-how and Fairchild's professional output in a harmonious sharing of research facilities and manufacturing plant.

On a recent visit to the plant, we were met by amiable Rick Belmont, the Fairchild sales manager, who guided

The plant in Commack.

Steve Friedman hard at work in the engineering department.



This is one of the earliest stereo cutter heads, Fairchild model 642. It was the first compatible stereo record system of its kind. (Photo courtesy of George Alexandrovich.)

us through both the Robins and Fairchild operations, with a running commentary that interwove descriptions of tomorrow-based research with vignettes of the past. We were joined by George Alexandrovich, Robins-Fairchild's V.P. of engineering and frequent contributor to **db**'s pages. George explained the easy transition that combined Fairchild with Robins. "Hy Post (president of Robins) and I have always kept in touch over the years with technical ties. This made it possible to move right into sharing facilities."

Robins manufactures many fine consumer accessory products and also makes punched tape and related items for the computer field. Although Fairchild's output is quite different, running to consoles, the two companies find common ground in the use of inventory area, shipping facilities, and the use of an impressive IBM computer. The complete and increased manufacturing facilities resulting from the merger now enables Fairchild to manufacture many of its own parts.

FAIRCHILD'S BEGINNINGS

Fairchild Sound was originally part of the Fairchild Camera and Instrument Corporation, of Jamaica, N.Y. Their products at that time included turntables, transcription arms, and related equipment. Gradually, as demand increased, the audio arm of Fairchild began to acquire prestige in its own right, known for sophisticated, innovative equipment. The sound division of Fairchild Camera was one of the first three companies in this country to develop tape machines, all of which were based on the German *Magnetophone*.

Finally, in 1948, the audio operation became autonomous, under the name of Fairchild Recording Equipment, moving to Whitestone, N.Y. The first professional tape machine was sold in 1949, volume reaching 100 in the first two years. By 1954, Fairchild was well established in the tape recorder business. In conjunction with this area, they developed pickup cartridges, designing the first reliable miniature moving coil cartridge, which became famous in both the professional and the high fidelity industry.

During the mid-fifties, the company dropped many of its professional audio products in order to concentrate on the burgeoning high fidelity demand. Until 1961, the firm was known for quality turntables, arms, amplifiers, etc. in this field. Beginning in 1957, after moving to Long Island City, they branched out once again into professional audio, along with their hi fi products. They developed the first compatible stereo moving coil cartridge for the recording trade, as well as a sterco cutting system and a new professional turntable, plus many other products. As the Fairchild name gained significance in professional audio, concentration became more and more centered on the professional products.

In 1961, Fairchild developed its first transistorized audio line, a development that marked the beginning of the concept of a complete audio channel. Many of these products included the first use of LDR's for controlling audio signals, the forebear of the firm's Lumiten.

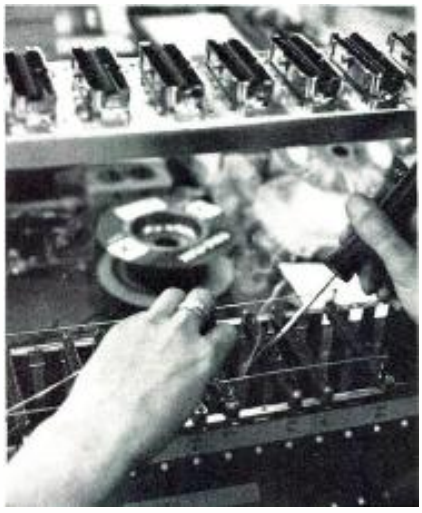
Such original products as remote control boards, audio processing cards, Lumiten attenuators, portable mixers, and specialized circuits, including the Ambicon and Reverberton came from the designing boards and production lines of Fairchild Sound.

CONSOLES OF EVERY KIND

Now, in their spacious 50,400 sq. ft. plant, Fairchild continues to turn out quality products, in the forefront of innovative production. Rick pointed out the 30000

The engineering lab uses an automatic frequency spectrum analyzer to check out prototypes.

Series 30000 compact broadcasting consoles ready for shipment.



A bird's eye view of the WKRC card files being mounted in their rack.

series of compact 8- and 5-channel broadcasting consoles, in varying stages of completion. These consoles use Fairchild's new RS-1000 (rotary sliders) sealed faders, inexpensive but very quiet, incorporating Allen-Bradley pots, a Fairchild exclusive.

Fairchild is also proud of their FPC-50 portable mixing console, which features 16 channels in and 8 out. Really compact, it measures only 27 x 28 x 2 inches and weighs 52 pounds. On the other end of the scale are their large custom consoles.

NOTABLE CUSTOMERS

Fairchild's reputation for quality and individualized service has brought them a clientele that reads like a *Who's Who* of the pro audio industry. One project they're deep into now is a custom remote control console, using Lumitens, for the Busch Gardens' Globe Theatre in Williamsburg, Virginia. This system will be the first to use a remote light-activated board in conjunction with a complete special effects and decoder system.

While we were chatting with console project engineer Steve Friedman, a customer, Ken Burros of Creative Theatrical Services in New York and Las Vegas, dropped in with an FPC-50 console for its two-year checkup. Ken's company does sound reinforcement for people like Steve and Eydie Lawrence, Tom Jones, and other top entertainers in Las Vegas and on tour. He had just finished working out the sound on Frank Sinatra's live performance at Madison Square Garden in New York City. His FPC-50, he told us, had once fallen from a plane during unloading (a drop of about 25 feet). He took it right to the job, set it up, and it still worked fine!

Other notable customers who use Fairchild products include NBC-TV, New York City (six wrap-around consoles), KCBS AM-FM, San Francisco (seven consoles), the U.S. Army Band, and scores of other well known broadcasting stations, studios, and users of public address systems. Under asembly now is a remote system for station WKRC, a Taft station.

MOVING AHEAD

Fairchild production at the present time is directed mainly at the custom designing of broadcasting, sound reinforcement, and recording equipment, with the bulk of the work ordered by the broadcasting industry, for whom they also manufacture stock items such as monitor amps, pre-amps, reverbs, circuit cards, attenuators, and other associated products.

On the drawing boards, according to George Alexandrovich, are a number of new products. "We're going to incorporate more advanced circuits with the use of i.c.'s and other technical improvements in the near future." He went on to add that Fairchild will seek new levels of marketing in sound reinforcement and more complete pre-packaged consoles for broadcasting. He sees an increased market for pre-built off-the-shelf products.

We left Robins-Fairchild with a satisfying sense of continuity, a good feeling in the midst of the shifting patterns of today's economy. From a timid "also ran" attached to a mother company to a prestigious position as one of the mainstays of the professional audio industry has been a big climb for Fairchild Sound during the past forty years. A creative attitude correctly foreseeing needs in the industry, plus a solid underpinning of service, has made this climb possible. We cannot help but feel that these values will continue to be the real basis for success. ■

MICHAEL RETTINGER

Recording Studio Acoustics, part 4

Resonance can be enhanced through judicious use of acoustic devices and certain building materials—slat absorbers, splays, suspended ceilings. Recheck your reverberation time after construction.

MARCUS VITRUVIUS POLLIO was a Roman engineer, architect, and acoustician who lived about 25 B.C. He wrote a treatise of ten books entitled *De Architecture*, in which the following text occurs:

> "7. Some will perhaps say that many theatres are built every year in Rome, and that in them no attention at all is paid to these principles of acoustics; but he will be in error, from the fact that our public theatres made of wood contain a great deal of boarding, which must be resonant. This may be observed from the behaviour of those who sing to the lyre, who, when they wish to sing in a higher key, turn towards the folding doors on the stage, and thus by their aid are reinforced with a sound in harmony with their voice. But when theatres are built of solid materials like masonry, stone, or marble, which cannot be resonant, then the principles of the '*echea*' must be applied."

The term echea refers to sounding vessels proportionate to the size of the theatre, constructed in niches between the seats, and facing the stage. Today we call such acoustic devices Helmholtz resonators, of which one commercial version goes by the name of Soundblox. Also, we

Michael Rettinger is a consultant on acoustics based in Encino, California.

have learned to use such devices as low-frequency sound-absorbents, in compensation to the reduced absorptivity which commercial acoustic tiles and plasters exhibit at the low frequencies. But the use of wood as a satisfying building material in concert halls still holds. It is without substitute because of its non-homogeneous composition, in distinction to plastic and metals, for which reason phenolic and aluminum violins have not been able to please any one.

SLAT ABSORBER PRACTICAL

A type of Helmholtz absorber known as slat absorber is frequently seen in American and European recording studios. Details of the unit appear in this writer's book, *Acoustic Design and Noise Control*, available through the offices of **db** magazine and will only be illustrated here.

Of the three Helmholtz resonators shown in FIG. 1, only Type C, the slat absorber, is really practical. The reason is that the low-frequency absorption of such a device is spread over a wide band of frequencies, while Type A and B are tuned to a narrow spectrum. Note how the slots of Type C vary in width and the space between the slats and the back wall varies in depth. Interestingly, the narrower the slots, the lower is the resonance frequency of the device. The reason is that this frequency is proportional to the area of the "mouth" of the unit and inversely proportional to the volume V behind the slats. Hence the deeper this space and the smaller the openings, the lower is the frequency where absorption takes place.

Note also the application of the sound-absorbent blanket or board directly behind the mouth of the unit, and not on the backwall, for most effective absorption. In practice the device can be made highly attractive by employing hardwood slats, stained and varnished, and an acoustic material behind the slats which is dark, like Owens-Corning Duct Liner, 1 in. thick, with its treated side facing the studio, so as to minimize the shedding of glass fibers. The top of the unit should be closed, and the entire assembly may be installed vertically or horizontally, that is, the slats may extend from floor to ceiling or they may run horizontally along the walls. The slats should be at least 1 in. thick; 2- or 3-in. thick slats are even more absorptive. There is no simple explanation why a little slot should absorb so much sound unless we assume that it acts as a sink for nearby air particles whose vibrational energy is changed into heat by their action in the slot against the absorbent.

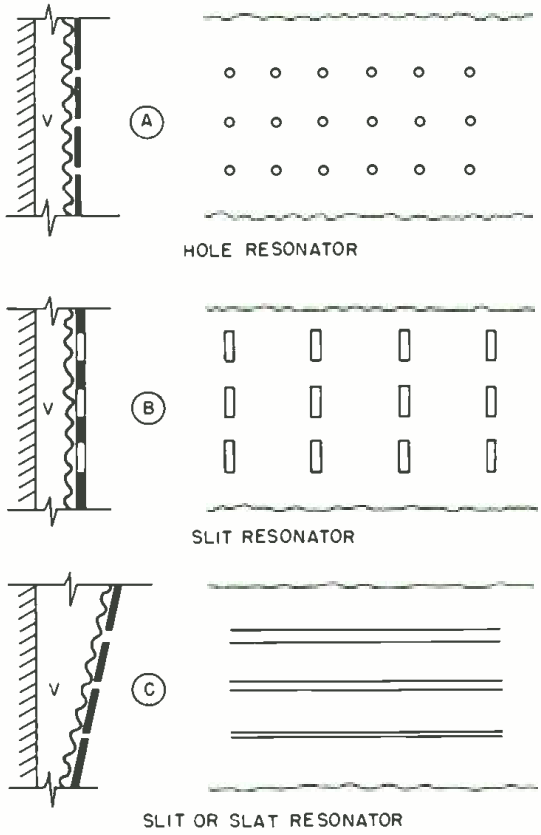


FIG. 1. Various types of Helmholtz resonators used as low-frequency absorbers.

EFFECT OF OTHER MATERIALS

The use of cylindrical wood splays in a recording studio is another preferred installation. It ensures the high-frequency resonance Vitruvius noted, provides a wide reflected wave front, and acts as a low-frequency absorber. They may also be constructed attractively of hardwood plywood. Spaced from the wall, these units may have a convex reflective surface and a flat absorptive back. Mounted on a vertical shaft resting on roller bearings, such splays can be rotated either manually or by an electric motor. In the scoring stage of the Burbank Studios in Hollywood, each side of the stage is furnished with six rotable splays, 6 ft. wide and 20 ft. high.

Petzold splays consist of vertical triangular columns, with every one of the three sides finished with a material of different absorptivity, from near .05 (plywood) to .90 (1-in. thick fiberglass).

The use of drapery for the achievement of variable reverberation is to be discouraged because such materials are extremely absorbent for the treble and little absorbent for the bass. Also, most such fabrics are not fireproof, gather dust, and can rarely be adjusted to the same position twice in a row.

If the floor of the studio is hard, as it should be to allow the preferred first reflections from the area of the instruments (for which reason many people like to sing in a shower), the ceiling should carry some absorbent material. Here one must be careful, if alternate hard and soft surfaces are employed, that the reflective ceiling panels are not parallel with the reflective floor, to avoid multiple or flutter echoes between these surfaces. Almost always, the rear wall of the studio (the wall the band faces)) should carry a highly absorptive material to minimize the "round-the-room" reflections so well liked in concert halls, but which are of little use in recording studios.

USE OF SUSPENDED CEILING

Another way to achieve high absorptivity for the bass in a recording studio is to employ a suspended acoustic ceiling so prevalent in offices for the same reason. The ceiling also hides unsightly air-conditioning ducts, electric conduits, pipes, and it allows recessed lighting.

FIG. 2 shows the absorptivity characteristics of ¾-in. thick Owens-Corning unpainted linear glass-cloth faced ceiling boards (one of this writer's favorite acoustic products) when installed on AIMA (Acoustical and Insulating Materials Association) mountings 2, 4, and 7. Note the dip in the curve at 500 hertz when the fiberglass panels are located 14 in. from the hard backing, and the peak of 250 hertz. The reason for the dip is that the 14-in. deep airspace corresponds to one-half wavelength of 500 hertz

(continued)

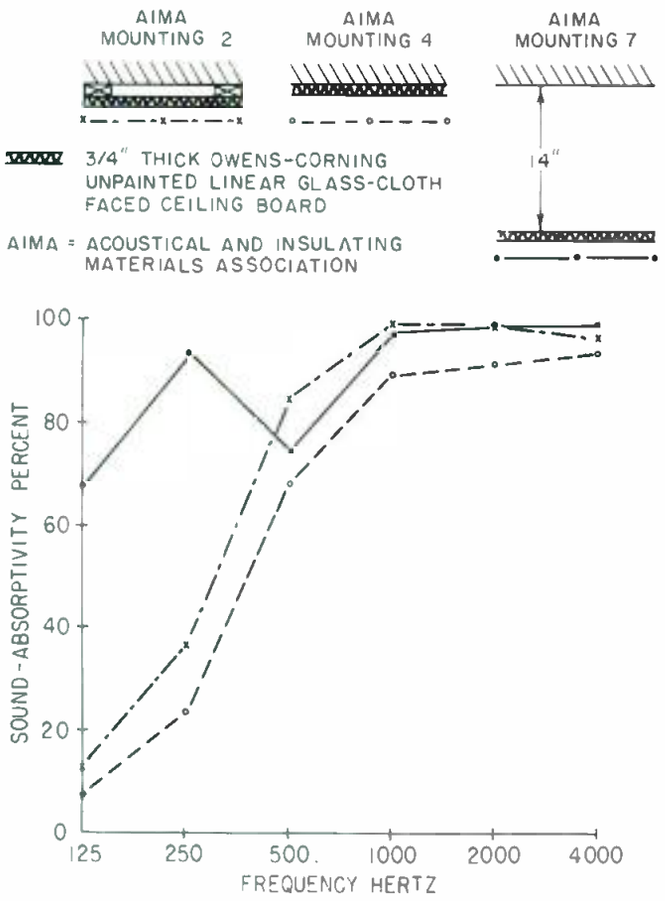


FIG. 2. Absorption characteristics of ¾"-thick acoustic panels on various mountings.

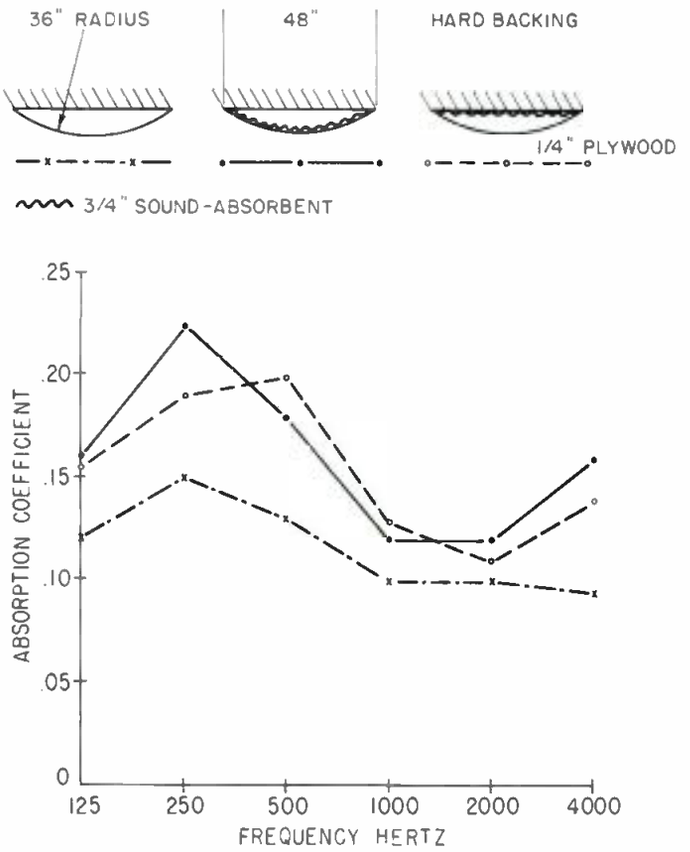


FIG. 3. Absorption characteristics of various plywood splays.

much as the peak corresponds to a quarter-wavelength of 250 hertz.

At a quarter wavelength the reflected sound has maximum air particle velocity, so that much of the vibrational energy of the wave can be converted into heat by the frictional resistance of the intercommunicating channels of the porous material. Similarly, at 500 hertz an interference effect exists between the direct sound entering the ceiling panel and the sound reflected from the concrete structural slab above the panel, and a dip results in the absorptivity characteristic. That is so for all types of porous panels with a deep airspace behind them and is not confined to the product illustrated. The dip in the curve can be minimized by slanting the ceiling so as to vary the air-space behind the panel and by applying a sound-absorbent material to the underside of the structural slab.

FIG. 3 shows the absorptivity characteristics of plywood splays employed so extensively in recording studies.

CHECK REVERBERATION TIME

The condition of a highly absorptive rear wall in a studio as well as the hard-floor, soft-ceiling combination introduces a somewhat non-uniform distribution of the acoustic material. Architects, studio engineers and others instructed in the Sabine and Eyring reverberation time equations and called upon to design a recording studio will find that discrepancies in the reverberation time can occur between the calculated period and the value finally measured in the room after construction.

For this reason their calculated times should be spot-checked with the more complicated Fitzroy* reverberation time equation developed for such cases of non-uniform absorption. If this difference is large, the Fitzroy equation should be employed in the design calculations because it is in better agreement with empiric data for rooms exhibiting walls with concentrated absorption.

The Fitzroy equation may be written in two forms, which tend to deliver very similar results, except in the case of anechoic chambers whose reverberation time is less than .1 sec. The equations are:

$$T' = \frac{0.049V}{S^2}\left[\frac{x^2}{A_x} + \frac{y^2}{A_y} + \frac{z^2}{A_z}\right]$$

$$T'' = \frac{0.049V}{S^2}\left[\frac{x}{-\lg(1-\bar{a}_x)} + \frac{y}{-\lg(1-\bar{a}_y)} + \frac{z}{-\lg(1-\bar{a}_z)}\right]$$

where $\lg = \log_e$
V = volume of room, cu.ft.
S = total interior room surface, sq.ft.
x and y = total area of each pair of parallel sidewalls
z = total area of floor and ceiling, sq.ft.
A_x, A_y, A_z = total absorption of x, y, and z
$\bar{a}_x, \bar{a}_y, \bar{a}_z$ = average absorptivity of x, y, and z.

■

*J. Fitzroy, "Reverberation Formula Which Seems to Be More Accurate with Nonuniform Distribution of Absorption," *Jl. Acoust. Soc. Am.*, V. XXXI, No. 7, July 1959, p. 893.

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FOR SALE: COMPLETE STEREO CUTTING ROOM EQUIPMENT PACKAGE: Neumann VMS-66 Lathe, compatible with SAF-74 system; with Leitz microscope; 4 PS-66 program modules: 33 (12"), 16⅔ (12"), 45 (7"), 22½ (7"); 1 EW68 dummy head for aligning suction pump with remote start; 1 ZA4 flow valve and regulator; 1 SX74 cutting head; 1 VG-1 stereo cutting electronics in rack; 1 STL-631 Ortofon low pass filter. Transfer console (electronics enclosure); with individual channel level sets and pan pots; monitor select for tape, console, feedback, TT; stereo/mono switch; ganged stereo fader for fades; individual program and preview vu's with range switch 0 to +12; miniature scope for phase check (MCD Transi-scope #300); Waveforms 401B oscillator; 2 Lang PEQ-Z equalizers; 2 Pultec EQP-1A; 2 Pultec MEQ-5 equalizers; 2 program hi-pass filters (30-70-120-250 CPS); 2 UA model 550-A hi-pass/lo-pass filters; 4 rows of 12 double jacks in patch field; 1 Fairchild #670 stereo limiter; 1 Sony stereo power amp #3120; 2 JBL #4310 speakers. Sony TS-1000 TT with Shure SA-1 preamp and arm. Scully TM-280 2-track ¼" with preview head. Price: $40,000.00. Contact: **Don Frey, A & R Recording, 322 W. 48th St., New York City 10036. (212) JU 2-1070.**

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DOLBY audio noise reduction systems model 361 NRU; 6 units on bank repossession. Send bids to **E. H. Moyer, P.O. Box 610, Gainesville, Fla. 32601. (904) 377-2265.**

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USED EQUIPMENT: Gately Prokits SM-6, EQ-6, EK-6 mixing group . . . $600.00; Revox A-700 7½ ips half track recorder . . . $500.00. Two AKG D-224E mics . . . $100.00 each. **George Swanson, 2006 E. 1st St., Duluth, Minn. 55812. (218) 728-2695.**

AMPEX, SCULLY, TASCAM, all major professional audio lines. Top dollar trade-ins. 15 minutes George Washington Bridge. **PROFESSIONAL AUDIO VIDEO CORPORATION, 342 Main St., Paterson, N.J. 07505. (201) 523-3333.**

AMPEX SERVICE COMPANY: Complete factory service for Ampex equipment; professional audio; one-inch helical scan video; video closed circuit cameras; video systems; instrumentation and consumer audio. Service available at **2609 Greenleaf Avenue, Elk Grove Village, Ill. 60007; 500 Rodier Dr., Glendale, Ca., 91201; 75 Commerce Way, Hackensack, N.J. 07601.**

AMPEX SPARE PARTS; technical support; updating kits, for *discontinued* professional audio models; available from **VIF International, Box 1555, Mountain View, Ca. 94042. (408) 739-9740.**

MODERN RECORDING TECHNIQUES by Robert E. Runstein. The only book covering all aspects of multi-track pop music recording from microphones through disc cutting. For engineers, producers, and musicians, $9.95 prepaid. **The Great Northern Recording Studio, Ltd. Box 206, Maynard, Mass. 01754.**

ONE AMPEX 300-top plate MCI electronics, two-track, in console, 7½-15 ips, $1,850; Ampex 351-top plate MCI electronics, two-track, in console, 7½-15 ips, $1,750; Ampex 351-top plate MCI electronics in Scully portable cases, two-track stereo, 7½-15 ips, $1,650; MCI 16-track tape machine with matching 8-track heads and guides, autolocator, in console, 15-30 ips, $11,500. **Criteria Recording Studios, 1755 N.E. 149th St., Miami, Fla. 33161. (305) 947-5611.**

B.B.C. REFERENCE MONITORS, pre-equalized J. B. L./Altec monitors; Dahlquist phased arrays; I. M. F. transmission lines; Infinity electrostatics; Crown/McIntosh 16 Ω/bridged bi-amps; Scully/Revox A-700 recorders; Micmix reverbs; Eventide phasors/omnipressors; Lexicon digital delays; dbx/Burwen N.R. companders; Little Dipper hum/buzz notch filters; Cooper Time Cube echo send; moving coil Supex/Ortofon; B & O straight line arms/cartridges; Schoeps/AKG/Sennheiser condensers; Beyer ribbons, U.R.E.I. comp/limiters/crossovers; Gately pro-kits; Q.R.K. tt. 1000s more. **Music & Sound Ltd., 11½ Old York Rd., Willow Grove, Pa. 19090. (215) 659-9251.**

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TASCAM REVERBS—$500; Tascam mixing consoles—$2,350; Tascam ½-inch recorders—$2,750; Tascam 8-track recorders—$4,600. All shipped prepaid/insured, including *free* alignment/equalization/bias/calibration. **Music & Sound, Ltd., 11½ Old York Rd., Willow Grove, Pa. 19090. (215) 659-9251.**

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SOUND EQUIPMENT WANTED: J.B.L. models 2440, 2470, 2350, 2355; also Crown amps, models DC 300 and D 150. Write: **Potomac Sound, 3109 Rosemary La., Hyattsville, Md. 20783.**

WANTED: FOR NORTHWEST AUDIO DEVELOPMENT, Phase 8 console: schematics, spare modules, or any information whatsoever. **Cliff Petroll, Charles Lane Studios, 7 Charles Lane, New York, N.Y. 10014. (212) 242-1479.**

WANTED: AMPEX SPEAKER/AMPS. A-692 series; new condition. **Audio Applications, 5½ Dorr Dr., Chepachet, R.I. 02814. (401) 568-5757.**

WANTED: Scully, Ampex, or other two- and four-track; good condition only; must meet specs. Also equalizers, compressors, etc. **David Coulter, (212) 679-7900.**

EMPLOYMENT

EXPERIENCED SOUND ENGINEER needed for 16-track studio: must have considerable knowledge in the music field; some maintenance experience needed; must have neat appearance and congenial personality. Submit resume and salary expected to **Box 22, db Magazine, 1120 Old Country Rd., Plainview, N.Y. 11803.**

RADIO NETWORK has opening for Broadcast/Recording engineer with five years' experience in radio drama production, music recording, and multi-track work and field remotes. An EOE and affirmative action employer. Eastern area. Send resume and list of production credits to: **Personnel Office, National Public Radio, 2025 M St., N.W., Washington, D.C. 20036.**

POSITION DESIRED: Recording experienced on A.P.I. and Ampex. Career position desired; willing to relocate if offer secure. References. **Mario J. Salvati, 271 Third Ave., West Babylon, N.Y. 11704. (516) 893-0266.**

db people/places/happenings

MASON

HODGES

CROWELL

SMALL

● **Kenneth M. Mason** has been elected president of the **Society of Motion Picture and Television Engineers.** He will serve a two year term. Mr. Mason is an assistant vice-president of **Eastman Kodak Company** and general manager of the company's motion picture and audiovisual markets division. He has been with the firm since 1935, except for a period of service with the Navy during World War II.

● **Marvin P. Hodges,** coming from **Eastman Kodak,** has been appointed president of **International Audio Visual, Inc.** of Seattle, Washington. Mr. Hodge will be involved with the company's new line of 16 mm. sound projectors and Continu-Sound, a line of miniaturized continuous loop tape equipment.

● An aspect of the television industry, in the private sector, has been tapped in a recent agreement between the **Xerox Corporation** and **Cramer Electronics** of Newton. Massachusetts. The contract is for video equipment to be used by Xerox to establish the Xerox Private Television Network, a communications system within their Information Systems Group. The Cramer firm, under the project direction of **Marty Strauss,** made a study of Xerox' particular needs and will supply the equipment necessary to tailor the private t.v. system to its particular requirements.

● **La Salle Audio** of Chicago, has announced the opening of a branch office in Teaneck, N.J. under the management of **Irv Joel,** who comes from **A & R Recording. Howard Lieberman,** also formerly of A & R, will be sales engineer for the new office. The New Jersey headquarters will service the northeastern states. including the New York metropolitan area. The address is P.O. Box 373. Teaneck, N.J. 07066.

● A newly created position, technical assistant to the president, at **Amperex Electronic Corporation** of Slatersville, N.Y., has been filled by **Dr. Merton H. Crowell.** Dr. Crowell will be in charge of researching product needs in the field of electron tubes, semiconductors, integrated circuits and electro-optical devices. He is well known for his work in solid state electron tube technology and research, especially in the area of camera tubes and image intensification. Dr. Crowell comes to Amperex from **Philips Laboratories.** Previously to that, he was with **Bell Telephone Labs.**

● **Eric Small,** Broadcast Audio consultant, has moved to San Francisco from New York. His new address is 271 Columbus Ave., San Francisco, Ca. 94133. Mr. Small is representing **Nippon Columbia** in the **National Quadriphonic Radio Committee** tests being conducted in the San Francisco Bay area. He is also serving as technical consultant to the **Corporation for Public Broadcasting's** special project on radio for the print-handicapped.

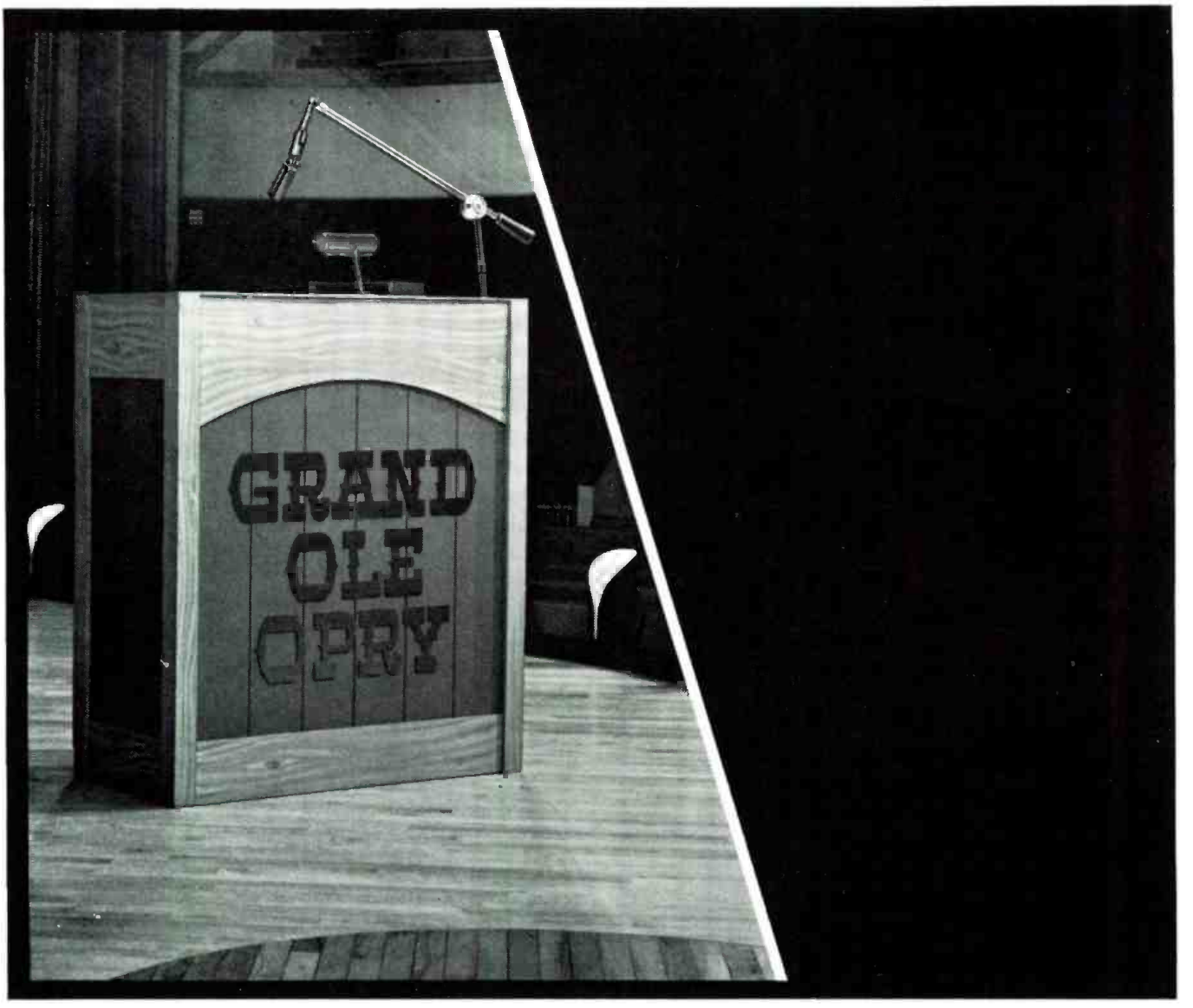
● **Sudden Rush Music** has completely renovated their 4-track studio in Riverdale, Bronx, N.Y. The studio, which has previously concentrated on music recording, will expand its services to include advertising work. The improved facility boasts a Dolby Noise Reduction system, as well as complete program Graphic Equalization. **Michael Berman,** composer and engineer, has recently joined the staff.

● A long term agreement has been reached between **N. V. Philips** and **MCA, Inc.** for the manufacture and marketing of a Philips/MCA video disc player. The agreement includes support video disc programming, combining the techniques which have been used in each company's video disc system so as to permit full interchangeability of video discs.

● **Goldmark Communications Corporation,** a subsidiary of **Warner Communications, Inc.,** has been named communications consultant to the **New York City Convention & Exhibition Center Corporation** for the design and development of telecommunications systems functions and services. They will be working in cooperation with architects **Skidmore, Owings and Merrill** to accommodate all communications services at the $200-million Center. Among the communications services being considered are an integrated communications transmission network for electronic registration of visitors, information retrieval methods, automated parking control, teleclinic facilities, information processing, and television and recording facilities. Looking toward the future, plans are being formulated for the use of satellite transmission of programs originating in the New York City center, to worldwide audiences.

● **Brigham Young University,** in Provo, Utah, will once again offer its intensive three week summer program from June 9-27. This is a five-day-a-week study, carrying with it a full semester's work, which can be audited or taken for three university credits. Specific workshops will be held dealing with micophones, loudspeakers, and consoles. Application of principles covered in lecture sessions on basic electronics, voice and musical instrument tone generation and acoustical engineering will be made in actual situations. The amount of material covered has been increased with the introduction of individualized audio/visual packages, adaptable to the student's needs. **Norman Crowhurst, db** columnist, will return to the seminar again this year. Due to limited space, prospective students are urged to make application early. Contact **Russel Peterson, Brigham Young University, Audio Recording Technology Course, 242 Herald R. Clark Building, Provo, Utah 84602, Phone (801) 374-1211, Ext. 3784.**

● A combination of **Du Pont** manufactured cassettes and **Norelco** VCR player/recorders has been initiated by an agreement between Norelco, a division of **Philips Broadcast Equipment Corp.** and the Magnetic Products Division of the Photo Products Department of Du Pont. The cassette will be sold under the Du Pont brand name, and will include capacities of 20, 30, 50, and 60 minutes running time.



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