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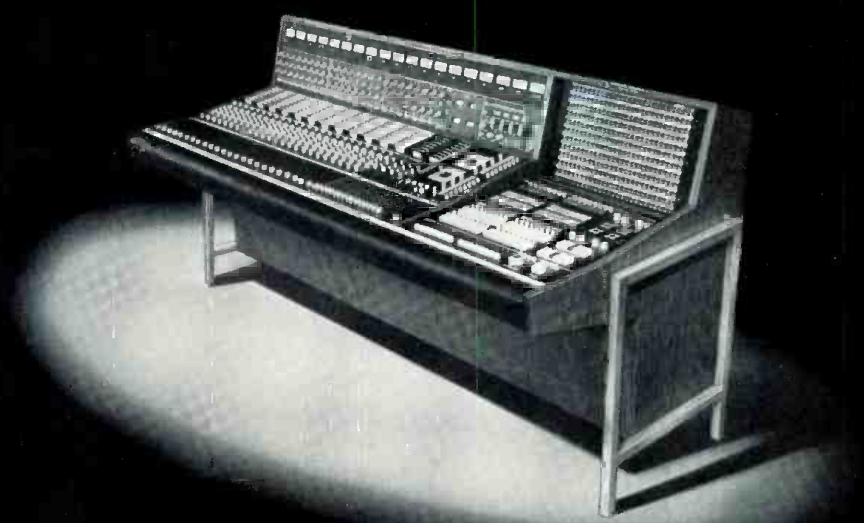
THE SOUND ENGINEERING MAGAZINE
MARCH 1972 $1.00



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COMING NEXT MONTH

• Walter Jung has submitted the first installment of a series that will explore the technology of digital electronics as it applies to professional audio. This article is entitled AUTOMATING THE AUDIO CONTROL FUNCTION.

A STEREO CONSOLE YOU CAN BUILD by Dick Kunc will prove to be of interest to many, particularly broadcasters that need to tote around equipment and want it to be as flexible as they can need.

Westlake Audio is a new Los Angeles-based distributor of professional audio equipment. Our camera poked its lens in when the opening party was going on, and then once again to produce a db VISITS story.

There will also be a map of the west coast AES Convention that is coming up May 2-5. It will tell you where to find each exhibitor.

And there will be our regular columnists: George Alexandrovich, Norman H. Crowhurst, Martin Dickstein, and John Woram. Coming in **db**, The Sound Engineering Magazine.

ABOUT THE COVER

• The input center without which all audio is of no value.

db

THE SOUND ENGINEERING MAGAZINE

MARCH 1972 VOLUME 6, NUMBER 3

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

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George Alexandrovich

THE AUDIO ENGINEER'S HANDBOOK

Simple Circuits Everyone can Appreciate

● What fascinates me most in reading electronic magazines these days is seeking simple circuits suggested by electronics engineers making the chore of designing new, yet economical circuits at times fun. I'm sure that anyone who has had to throw a small power supply together from components at hand, or build a filter or any other circuit needed in an half an hour will appreciate these few ideas I have gathered over a period of time.

Let us begin with one of the most useful of circuits. How many times have you looked for a high-power zener only to price one and wish you hadn't looked into the catalog. FIGURE 1 shows you how to take ordinary ¼-watt zener and amplify its current carrying capability—using a less expensive power transistor. If you don't have an NPN power transistor, a PNP can also be used providing you change the polarity of the zener and call the plus *minus* and minus side *plus*.

FIGURE 2 goes a step further. It gives you the zener without using a zener diode. Any two PNP and NPN transistors—with couple of resistors and a pot—will give you a zener effect with very low impedance at low voltages, where ordinary zener diodes have impedances much higher than that of this circuit. Also a very sharp knee is characteristic of this circuit. Aside from the fact that it is simple and has variable zenering voltage it is also useful in the 1-3 volt range where ordinary diodes are not very good. The formula to find the zenering voltage for this circuit is:

$$E = \frac{½\ (R1 + R2)}{R1}$$

Let us now try to describe a circuit which would get rid of bulky inductors and the high cost of making them. FIGURE 3 shows an ordinary operational amplifier generating the functions of an inductor. Again, the circuit is simple and lends itself nicely to miniaturization—with the added advantage of not being susceptible to magnetic fields. As shown on the schematic, inductance of the circuit depends on the values of the resistors

advertisers index

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THE SOUND ENGINEERING MAGAZINE

16-track means Dolby System

There isn't any other way.
If you want to produce good, low-noise stereo releases from 16-track master tapes, the Dolby System is the only way to get them without changing the sound. Even if you start with the best tape. That's it.

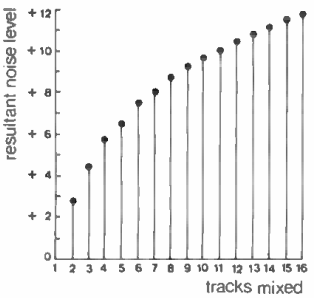
Figure it out: every time two tracks are mixed together, directly or indirectly, their noise adds – cutting 3 dB from the signal-to-noise ratio of the original tracks.

Mixing sixteen tracks down to two will lose at least 9 dB this way – much more than can be recovered by the use of any special tape or speed. Since the signal-to-noise ratio depends upon the area of tape used per unit time, using the Dolby System is like running your tape at 12 feet per second! Or, if you prefer wide tapes instead of high speeds, you can use tape 20 inches wide! Either way, the Dolby System is by far the better deal.

In fact, the Dolby System will give you 10 dB of noise reduction, plus the same reduction of hum, crosstalk or any other sound that wasn't on line-in.

Putting it all together.
Sixteen Dolby units stack in just 28 inches of rack space. In a pinch, they can be stacked anywhere that a pair of bookshelf speakers will fit, because total volume is just over three cubic feet. The regular lines to and from the recorder will go to the Dolby units instead; XLR connectors for the cables are supplied with the noise reduction units.

Lining up the system is just like checking line level in and out of your recorder. Put a standard NAB or DIN test tape on the machine and set studio line level; then put on a reel of blank tape and set record level. You adjust everything from the front, using meters built into the Dolby units. You can still use any tape you want, record at any level you want, except that from then on you get a 10 dB better signal-to-noise ratio.



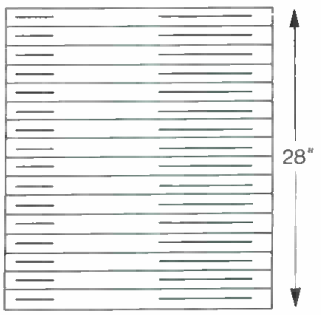
Any way you look at it,
more tracks mean more noise.

Using the system.
It is good practice to start every reel of tape by recording a section of Dolby Tone, which is generated by a distinctively modulated oscillator built into each noise reduction unit. There will never be any question of correct level with that reel again, at your own studio or any other one to which you send the tape. Decoding will therefore be perfect – for 100% maintenance of signal integrity.

Working up from the noise level, you can take some of the 10 dB as head room – for more relaxed, easier recording. You will be surprised how quickly you become addicted to the luxury of nearly dead silence *and* sparkling clean peak levels free of distortion.

With the Model 361 units, there is no extra operating bother, since the operating mode is automatically switched by your recorder. The Dolby Tone can be actuated from your mixing console.

Can you count on it?
The characteristics of your recorder and recording tape will probably vary more than the Dolby System. If you ever want to reassure yourself that the system is working perfectly – good engineering practice – we make an inexpensive device that tests a noise reduction module and the chassis in about one minute (NRM Test Set, Cat. No. 35). The test set is an easy to use plug-in unit; you can do the testing whenever you wish *without* external test equipment. If the meter reads "Test" in all 24 switch positions; the module is ok. If any test result is out of spec, pop in a spare module and let us worry about the other one – you'll get a quick replacement.



The entire sixteen units will take less space than a pair of bookshelf speakers.

Circle 20 on Reader Service Card

Special tape – that was 10 dB ago.
The purpose of the Dolby System is to let good engineers come closer to perfect recordings. Used with today's best tapes, it gives skilled engineers a chance to show what tape can really do.

Take the distortion treatment that ordinary recordings give to drums. Good producers – those who ask to compare recorder line-in and line-out – learned a long time ago that non-Dolby tapes actually change the sound of drums because of the high peak levels needed to stay above the noise, even with the best tape you can buy. With the Dolby System, you can record at more conservative levels and get a perfect line-in, line-out match. If your business is recording sound (instead of re-arranging it), Dolby is the only way to record drums – or any other sound.

The bad news.
Sixteen of the Model 361 Noise Reduction Units sell for $11,840; a spare noise reduction module is another $425; the NRM Test Set $140.

What do you do next?
First, whether you think you'll buy now or later (or maybe not at all), get someone from Dolby over for a demonstration. Satisfy yourself that what is printed here is correct. Call (212) 243-2525 and we'll arrange to set the system up in your studio.

Dolby Laboratories Inc
333 Avenue of the Americas
New York NY10014

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R1 and R2 and capacitor C1. Q of the circuit at high frequencies is around 10 but by reducing the value of R1, Q increases.

The next circuit, in FIGURE 4, achieves the same results using a gyrator circuit. Ordinary gyrator circuits require a change of capacitance in order to obtain change of inductance. Using a second operational amplifier eliminates the need for the limited range variable capacitors. Input impedance of the circuit is:

$$Z = \frac{R}{1 - \frac{1}{C1\ R1}}$$

The next circuit is one that concerns old-timers in the audio field who sometimes feel an irresistible urge to match impedances with the modern low output impedance amplifiers. I hope that oldtimers will not be too angry with me for these words because I will confess that quite often we have to match impedances whether we like to or not. For instance—going into a telephone line from an amplifier which has a fraction of an ohm output impedance may be most disconcerting to the telephone company. Most radio stations just put a 6-dB pad on the output to isolate the amplifier from the line. But you then lose 6 dB (or half the voltage or 75 per cent of power). The circuit in FIGURE 5 shows a basic amplifier circuit with positive feedback reducing the losses to 15 per cent due to impedance increase at the output. However, soon after I read about this circuit, another one appeared with losses of only 10 per cent. And it is also simpler. FIGURE 6 shows this circuit and the formula to develop needed values. The most important part of the circuit is the fact that it uses a small resistor in series with the load. With the load resistor being 150 ohms and a voltage

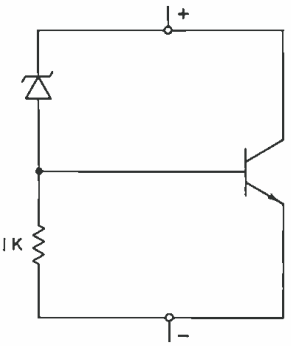
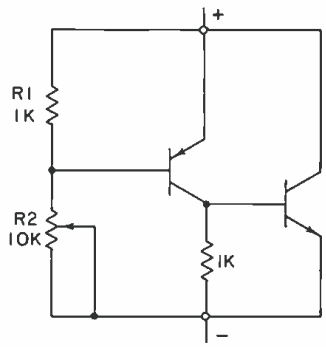


Figure 1. Amplifying the current-carrying capacity of a zener.

Figure 2. Here's a zener without a zener diode.



you write it

Many readers do not realize that they can also be writers for **db.** We are always seeking good, meaningful articles of any length. The subject matter can cover almost anything of interest and value to audio professionals.

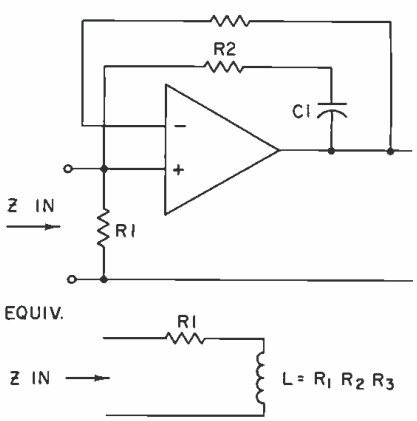
Are you doing something original or unusual in your work? Your fellow audio pros might want to know about it. (It's easy to tell your story in **db.**)

You don't have to be an experienced writer to be published. But you do need the ability to express your idea fully, with adequate detail and information. Our editors will polish the story for you. We suggest you first submit an outline so that we can work with you in the development of the article.

You also don't have to be an artist, we'll re-do all drawings. This means we do need sufficient detail in your rough drawing or schematic so that our artists will understand what you want.

It can be prestigious to be published and it can be profitable too. All articles accepted for publication are purchased. You won't retire on our scale, but it can make a nice extra sum for that special occasion.

Figure 3. Getting rid of bulky inductors. Zin = R1 + C1, R1, R2.



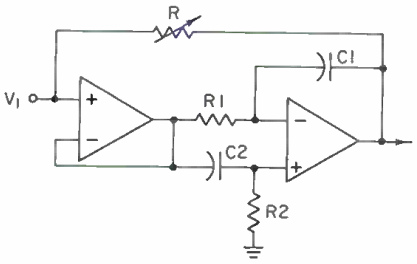


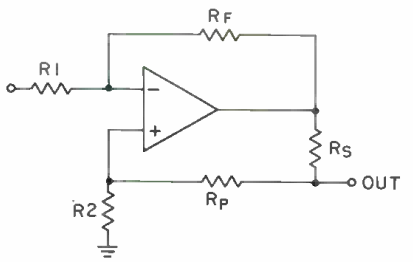
Figure 4. The function of Figure 3 using a gyrator. C1, R1 = C2, R2; L = C1, R1, R.

gain of the circuit of 5, value of Rs is only 15 ohms—which is 10 per cent of the load resistance. One disadvantage of the circuit is that the load ground is not at earth potential. But when we consider that we have to isolate the telephone line by using a transformer, this problem no longer exists. If you are going to use a transformer I suggest you measure what increase in impedance you should expect from the transformer coils.

As a reminder of how to measure source impedance: when you connect the load, output voltage should drop 6 dB. If you are connecting a 150-ohm load to the secondary of the output transformer, while measuring the voltage across the winding, and you read a drop of let us say 8 dB you know that the source impedance is higher than 150 ohms. In this case change the load to the known value which would produce exactly a 6 dB drop. For example, if load resistance is now 200 ohms, this tells you that the transformer introduced an additional 50 ohms. What you should do is readjust resistor Rs to a smaller value so that the output impedance of the amplifier (instead of being 150 ohms) is only 100 ohms. The additional 50 ohms are obtained from the ohmic resistance of the transformer wire.

All of these seemingly unimportant circuits are creating a tremendous technological changeover and progress. Elimination of inductors, amplification of capacitance using transistors —these two circuits alone are capable reducing the size of our equipment to chips with component densities of over

Figure 5. A basic amplifier circuit with feedback reducing the losses. Rout = 6Rs.



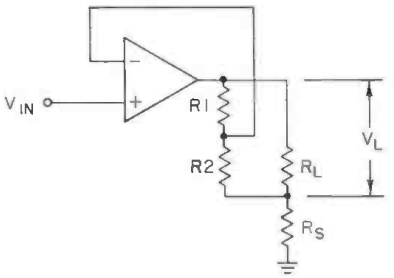
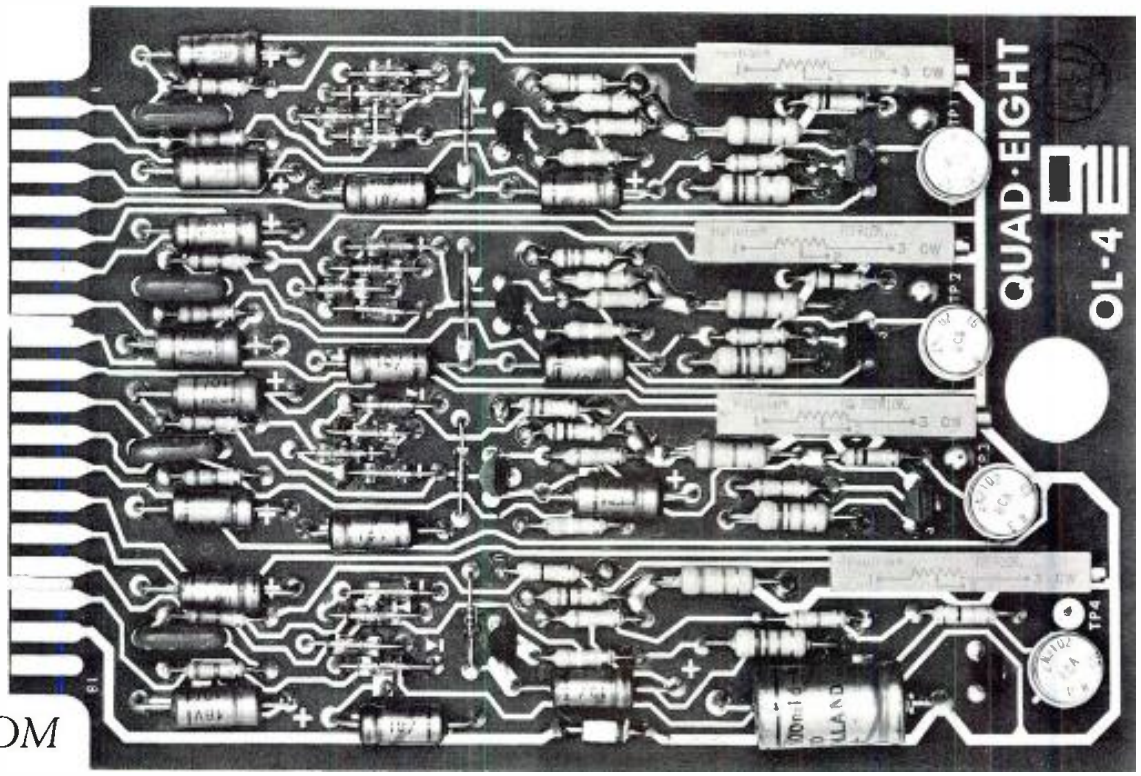


Figure 6. $Zo = \frac{Rs + 1/A\ (Rs + Ro)}{1/A + R2/R1 + R2}$.

A = open loop unloaded gain
Ro = open loop output resistance

1,000,000 elements/square inch. We have learned how to balance circuits without transformers, operate with a minimal amount of wasted power, and deposit on i.c. chips complete systems, calculators, computers, memories—and there is no end in sight. We should all benefit from these advances, although originally they were not meant for audio engineers. The ability to extract useful circuits from the information published by computer or space scientists allows us to realize those gains which may be hidden from us when we watch them send men to the moon or spend years on developing integrated-circuit techniques. ■

COMPONENTABILITY



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Norman H. Crowhurst

THEORY AND PRACTICE

● As recent discussions have centered around measurement we will continue here by taking a look at ways of measuring frequency. This should not be confused with signal analysis, which finds out what frequency or frequencies are present in a given signal. This has an element of frequency measurement, but is not concerned with precise determination of frequency *per se*.

The earliest efforts I remember, used to determine audio frequencies, would start with a selection of tuning forks or other frequency standards, preferably capable of being maintained in oscillation. These would be used to calibrate an audio oscillator, constructed to achieve the highest possible stability, and then the oscillator would serve as a secondary standard for frequency comparison.

In those days, the best way to reference a variable frequency against a fixed standard was to listen for a zero beat between them. If the frequencies differ at all, their difference frequency is audible as an intensity-varying beat. If the intensity exhibits ten maxima and minima per second, precisely, the difference between the two frequencies would be ten hertz (called *cycles* in those days).

If a slower beat could be obtained, that was a closer determination of the identity of the two frequencies. And by going *through* the zero beat with the variable oscillator, it was possible to tell which is the higher or lower by the difference counted in the beats.

Of course, the most accurate determination would be if the variable oscillator could be set so the beat vanished, called *zero beat*, because the two frequencies are identical. The danger in doing this is that any stray coupling at all between the two sources may pull one or other oscillator. If this happens it means that, although the two frequencies are identical while they are both functioning together at the same frequency, one or other might move to a slightly different frequency if the other was not present at the same time.

The harder zero beat is to achieve, the less pulling can be occurring. If you can adjust frequency so that one beat occurs every ten seconds, there is likely to be very little pulling.

The zero beat method can be used for comparing frequencies close to identical, or close to an octave relationship. To a lesser degree, it can be used to compare frequencies having a simple ratio, such as 3:2 or 4:3. Obviously, if you have only a few standards, and use all the ratios and octave multiplications and sub-multiplications you can, this still leaves substantial gaps in calibration of the audio range.

The precision of zero beat has quite different significance at different points up and down the audio scale. At 20 Hz, for example, two beats per second represents a two per cent error, apart from any pulling that may be present. And you may not be listening to a beat between two 20 Hz fundamentals, but to a beat between harmonics of 20 Hz, which would lower the percentage error by that factor.

If the frequencies you are beating are 5,000 Hz, and again the beat is two per second, the accuracy is 0.04 per cent. The beat is probably a lot more tricky to adjust, too.

When computer technology led to the widespread development of counters, timed by standard time intervals, such counters could serve very easily as digital frequency meters. If the internal time standard chosen is one second, the counter would count periods for precisely one second and then stop, so you could read how many cycles occurred in that second. It could then be reset to take another reading, over a successive second.

This is fine, for higher frequencies. If you are at 5,000 Hz, for example, and the reading is 4,998, that means the average frequency, over the second during which the counter counted, was 4,998 Hz ±0.5 Hz. But if you are at 20 Hz, and the reading is 20, the average frequency is 20±0.5 Hz, which reduces the accuracy to ±2.5 per cent.

An alternative method can be used, often with the same instrument, for the lower frequencies. The instrument usually contains a frequency standard, possibly 1 MHz, which is used to measure off the standard time intervals when used as a counter. The alternative method connects the counter differently, so it counts the standard frequency against a period of the frequency being measured.

Thus, if the frequency being measured is 20 Hz, the instrument should read 50,000. If the reading is 1 more or less than 50,000, this represents a deviation of ±0.002 per cent. This is far more accurate than any zero beat method can achieve at this end of the spectrum. Of course, it loses accuracy at the other end. At 5,000 Hz, the reading would be 200, which means accuracy can only approach 0.5 per cent.

Convenient as the counter is for measuring frequency, it has one shortcoming: it can only measure average

Introducing a SONY® turntable for the lazy perfectionist

If you're a perfectionist, you wince at the thought of stacking records, naked and defenseless, or dropping them onto each other. So you wind up with a single-play component turntable, and hold your breath to raise and lower the arm gently and perfectly.

If you're lazy, though, you resent having to dash across the room at 20-minute intervals to lift the stylus from the run-out groove. And you wind up with an automatic turntable. (Which perfectionists still call "changers.")

But if you're a lazy perfectionist, where can you turn?

To Sony, of course. And to our new PS-5520.

Just give its control lever a lazy little nudge, and things start happening—things to delight the perfectionist in all of us.

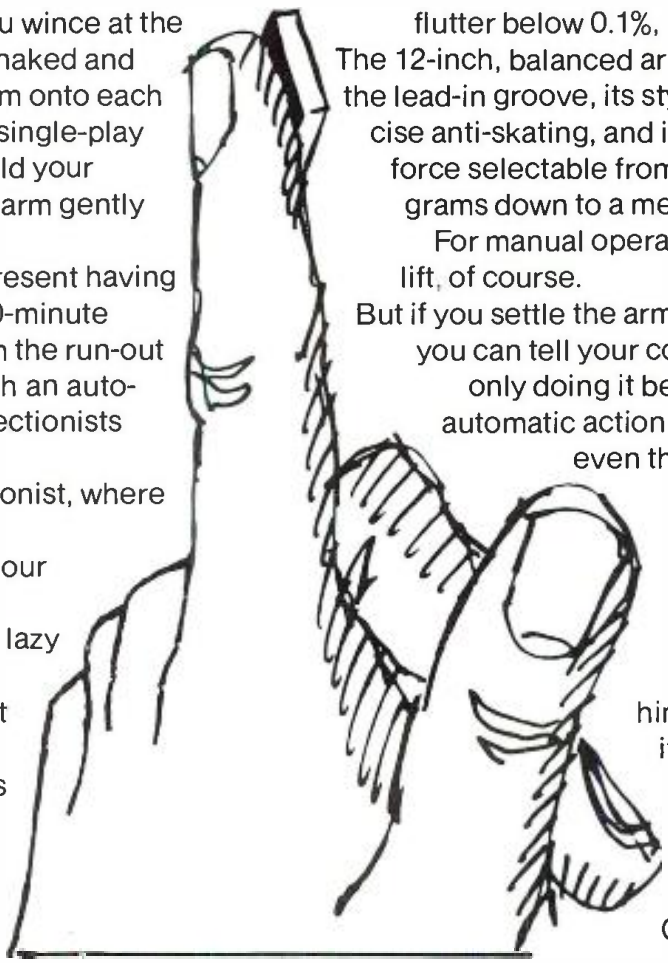
The hysteresis motor starts the 12-inch non-magnetic platter turning at precisely 33-1/3 or 45 rpm. (Belt drive keeps wow and flutter below 0.1%, rumble down 42 dB.)

The 12-inch, balanced arm settles precisely in the lead-in groove, its stylus centered by precise anti-skating, and its calibrated tracking force selectable from a maximum of three grams down to a mere fraction of a gram.

For manual operation, there's a cueing lift, of course.

But if you settle the arm down automatically, you can tell your conscience that you're only doing it because the PS-5520's automatic action is so gentle. Gentler, even than you are when you hold you breath and brace your elbow.

The Sony PS-5520 turntable. Complete (less cartridges) with walnut base and hinged dust-cover. See it at your Sony dealer. Or write Sony Corporation of America, 47-47 Van Dam Street, Long Island City, New York 11101.



New SONY® PS-5520 Turntable

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over the period used to make the measurement. You may argue that frequency can only be measured over a period. But how about a musical vibrato? The average is the center pitch, from which it may vary, during a fraction of a second, by several per cent, plus and minus.

You would probably not want to measure the frequency of a vibrato note. But oscillator's frequencies can vary to a lesser degree. Maybe the oscillator's frequency fluctuates with supply voltage, which may be derived from a 60 Hz supply and have a 120 Hz ripple on it. Thus frequency may go up and down a little during every 120th of a second.

You would not discover this with the counter method. Or you might notice that the count registered varies a little, due to the different points on the fluctuation at which the counter starts and finishes.

This is where it is nice to be able to observe an instantaneous frequency comparison. And a very simple method enables this to be done. It uses Lissajous figures on a cathode-ray oscillograph. Instead of the conventional time base, each frequency is applied directly to one of the input amplifiers: one to the horizontal, one to the vertical. The 'scope then traces a pattern showing the relationship between the two frequencies.

The simple ratios are easier to spot and identify than the more complicated ones. In the attached set, the top row all represent the simple 2:1 pattern, in which the frequency applied to the vertical is exactly twice that applied to the horizontal.

The difference is in the momentary phase relationship between the waveforms of the two frequencies. If the frequencies are not in exactly 2:1 ratio, the pattern will rotate looking like the top three figures at different points in its rotation.

The next row of figures show various steady displays produced when the ratio is 3:2. The vertical frequency is exactly one and a half times the horizontal frequency. This too will rotate if the ratio is not exact.

You will notice that the pattern at the left end of the row is easiest to recognize in each case. This is because the trace retraces itself, giving the appearance of *ends* where it turns back. The number of loops along the top or bottom, compared with the number of loops along either side, give the ratio of vertical input to horizontal input frequency.

Using the simplest form, a sort of *locktrace* (although it should not lock electronically) you count the loops twice and the ends once. The remaining patterns show some examples of slightly more complicated ratios when adjusted to the locktrace position.

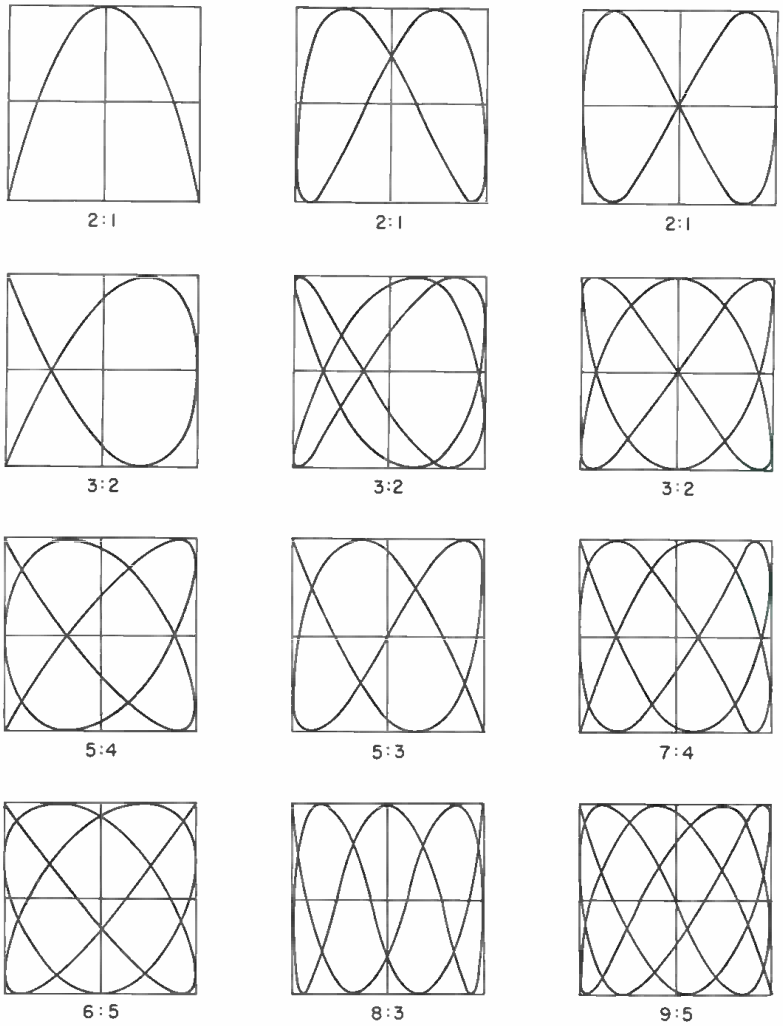

Figure 1. The various patterns.

Any ratio is like a simple fraction, with numerator and denominator. And fraction reduced to its simplest form must have an odd number for either numerator or denominator or both. If both numbers are even, it is not the simplest form, because both are divisible by two.

If the number representing the horizontal frequency is even, both ends will be at one side, left or right (note 3:2, 5:4, 7:4). If the number representing the vertical frequency is even, both ends appear at either top or bottom (note 2:1, 6:5, 8:3). If the numbers representing both frequencies are odd, then the ends appear at opposite corners (note 5:3, 9:5). These rules aid in identifying patterns.

If the frequency fluctuates at all, the pattern will not be steady, or it may show a double or broadened image, because the spot fails to retrace its steps perfectly. These variations can often be interpreted by careful examination, giving far more information than is usually available from a counter-type measurement.

To give some idea of the coverage Lissajous figures will give, here are the frequencies that can be obtained using a 1000 Hz standard, and patterns with no more than five for the horizontal, shown by two loops and an end at left or right. 1,000 Hz (circle or line); 1,200 Hz (6:5); 1,250 Hz (5:4); 1,333 Hz (4:3); 1,400 Hz (7:5); 1,500 Hz (3:2); 1,600 Hz (8:5); 1,667 Hz (5:3); 1,750 Hz (7:4); 1,800 Hz (9:5); 2,000 Hz (2:1).

And so on up the scale. Further aids in pattern identification can be derived from the rows of intersections across the middle of the patterns, which are easier to recognize or identify than the loops along the edges. It is not very difficult to identify frequencies at 10 per cent steps of the standard, with a little practice. For the more complicated patterns, the simpler ones in between serve as an aid to being sure which one you are looking at. ■

The Quietest Revox

One of the most compelling reasons for buying a Revox is the sounds it doesn't make.

No spurious pops or clicks. No wavering, fluttering tones. No distracting hum. And best of all, virtually noise-free electronics.

Take our new A77 Mk III for example. We manufacture it to such close tolerances and with such exacting attention to detail, that it is generally regarded as one of the quietest tape recorders ever made.

Unfortunately, no matter how quiet our electronics are, there is still the inherent problem of tape hiss.

And that's where our new Revox A77/ Dolby B recorder comes in.

By now, the virtues of the Dolby Noise Reduction system are too well known to require any elaboration on our part.

Suffice it to say, for all practical purposes the last major stumbling block to quality, noise-free recording has finally been eliminated.

Listening to tapes on the new Revox/Dolby B is a revelatory experience. Tape hiss is virtually non-existent. The music seems to emerge from a background of velvety silence. And at 3-3/4 i.p.s. the absence of extraneous noise is truly startling.

But no mere description of the Revox/Dolby B can adequately convey the experience awaiting you the first time you listen to a tape made on this remarkable machine.

Your nearest Revox dealer will be delighted to audition the Quietest Revox for you. Once you've heard it, you'll understand why we say...

Revox delivers what all the rest only promise.

The Revox/Dolby B

Revox Corporation, 155 Michael Drive, Syosset, N.Y. 11791. Calif.: 3637 Cahuenga Blvd. West, Hollywood 90068

Circle 17 on Reader Service Card

Martin Dickstein

SOUND WITH IMAGES

Projection In The Theater

● Until recently, mention of a projection facility brought to mind a setup in a board room, an auditorium, a classroom or, on a large scale, perhaps a World's Fair. Within the past few years, novel ideas and applications have come from the concepts presented in Fairs, such as industrial displays and traveling shows including sales meetings.

Among the new users of projection systems is the legitimate theater. It is not common knowledge, even among audio-visual specialists, that a tremendous amount of projection has been introduced in the recent past in stage presentations shown on Broadway. Here, the term projection is not limited to the film presentations of the movie houses or even to simple slide displays, but includes use of various triggering techniques—lamp housings with specially designed masks, new methods for producing the slides and films and the application of available or custom-built devices to create the effects desired for the show.

One company, which specializes in lighting design, has become deeply involved in creating special effects for stage productions through the utilization of some standard equipment, some available but modified equipment, and some systems using specially designed devices. This is because there was nothing available to accomplish the desired result in the stage setting. Within the past few years, Jules Fisher Lighting, Inc., has provided equipment design, slides made specially or shot from original art work, and creative innovations to help in the total visual effect of several Broadway shows.

Mr. Jules Fisher, young head of the company, presently working on several projects both in this country and overseas, believes that lights, normally used for seeing and for safety, should also be used for comfort and for interesting and restful background. In a similar manner, projection could also be used for background to create "scenic beauty or emotional enjoyment."

One example might be in a board room or a waiting room or lobby. Curtains could be hung on one wall with projected images presented on another wall showing the company logo or products, photographs of plants or scenic views, or just random designs. Use of slow-changing cycles or dissolves could create interesting and restful effects.

For the theater, Mr. Fisher feels that the projection image must be a definite part of the show and must come from within the show itself. The projected image must help to create the mood of the scene, carry forward the action of the play, or provide the sets and background for the presentation itself.

Several novel techniques have been devised for theater projection which may or may not be applicable to the smaller board room or conference room installations, but they may prove helpful in some instances where the imagination can be exercised. For example, it is essential that all slides be mounted in glass. This, obviously, is to prevent careless hands from touching, and perhaps destroying, the film itself, thus avoiding a fingerprint on the desired image. Also, the glass mount keeps the slide firm in the frame and prevents buckling during projection heating.

Where the projected image need not be definable but must be quite bright in order to be effective, large format slides should be used to provide as much light as possible at the image through avoiding the need for very large magnification factors. Projectors are now available which utilize slides that are larger than the usual double frame 2 x 2 slide, such as those that project lantern slides (3¼ x 4¼), some that use slides 5 x 7, and one or two that can project slides 7 x 10. These projectors are made with high power light sources ranging from 3 kW to 5 kW and 10 kW. Some of these are incandescent so that they might be dimmed without requiring a mechanical douser as in the case of the arc lamp. It is suggested that if a photo is used in the slide that the 2 x 2 format be used for greater definition. On the larger format projectors, there are those that can change up to 70 slides on a large wheel, while the very large format projectors are usually limited to 10 slides.

For stage projection, it is sometimes required to create special effects which can not be put on film. Where the design or image is to be of special pattern or requires a particular color, it is possible to use the large format idea and actually paint the desired original art work right on the glass itself. With no film being used, the design can be physically changed as often or as much as necessary. Brighter colors are thus possible and even these can be changed readily.

Another interesting effect is created by using an ordinary spot light, of the intensity desired, and mounting a metal template in front of the lamp. The template is cut out in the desired pattern and white or colored shadow images can then be cast onto the stage or the scenery as required. This also permits projection of a large image of the desired intensity where a projector with a film slide might prove to be inadequate.

A few of the Broadway shows using projection facilities as part of the presentation in recent years (Mr. Fisher was associated with some of them) required rather complex and sophisticated systems, while others needed fairly simple setups. A few years ago,

When you buy MCI's new JH-416 mixing console—priced at a phenomenal $19,500 for the 16-track model—you'll have enough money left over to buy our JH-16 recorder ($16,500)... and still be paying less than what you'd expect for a comparable mixing console alone. Expandable to 24 tracks (total: $25,100), the JH-416 makes possible a complete studio package of heavy hardware at unheard-of savings. And to save even *more*, consider starting out with an 8-track version of the JH-416 ($13,900), which you can build on later.

We'll match our mixer—its specifications and functions—with any competitive model, even the $40,000-and-up jobs. For example, each input module of the JH-416 features: illuminated straight-line fader • four-knob equalizer • individual track/quad monitor assign with pan and level control • two cue feeds • two echo feeds • solo/preview • 16-track, plus direct bus assignment • overdub switching • sub master on each bus • plus much, much more for much, much less.

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for example, a show called *Inquest* made use of eighteen rear projection screens with two slide projectors on each screen. A dissolve effect was used to provide gradual change of slides. The image was background for the entire show, and in one case, it was possible to use the dissolve technique to create the effect of a plane moving across the background and dropping a bomb—which actually appeared to fall. A unique triggering mechanism was used to change the slides. Another slide projector was used with slides made of opaque material through which holes were punched in a definite pattern. The projector lamp shone through the holes onto an array of light sensitive cells which activated the circuits to change the image projectors. The effects could be changed simply by moving the triggering slides in any position desired or by removing any triggering slide and inserting another one on which the corrected holes had been punched. It is interesting to realize that during the change of slides in the control projector during operation, the time that the projector lamp was blocked during the slide change cycle did not affect the light cells—as they reacted only to the incident light hitting them. A total of about 80 slides per image projector were used in the show.

Another show using projection was *The Trial of Lee Harvey Oswald.* In this presentation, it was necessary to suspend from the overhead pipes, a screen 30 feet high by 50 feet long as there was no other way to put it up. The background scenes were projected onto the screen by six slide projectors, two high intensity (3 kW) projectors and a 16-mm film projector. Control was handled by a punched paper tape programmer. Incidentally, with the short throw distance available for rear projection, no mirrors could be set up so film had to be made in reverse to show correctly.

In the show *Two By Two*, the backdrop of various paintings of animals was created by front projection of six xenon slide projectors using up to 60 slides each. The projectors were modified to permit slide changes at speeds of about ¼ sec. with mechanical dousers.

More recently, the show *Lenny* made use of 2 projectors with 2000-watt incandescent sources to create a wide screen backdrop for the stage action. In one scene, a multitude of pairs of eyes, all different, were projected on the screen. For this effect, two separate slides were shot of the same original chart onto which the eyes had been pasted. In projection, one of the slides was reversed to create a uniform pattern across the screen. In another scene, a different projector was used to throw the image of a stained glass window on the screen to create a church effect.

In the show *Hair*, a xenon film projector is used to front project onto a scrim. Only two slides are used to create the image of the scenery for the stage action. In another scene, it was desired to create an over-all flower pattern on the stage. For this effect, xenon projectors were mounted directly over the stage and aimed downwards. The pattern, slides made of a design found on a piece of wrapping paper, filled the stage.

The most recent stage show on Broadway to use projection is *Jesus Christ Superstar.* A total of fourteen projectors are used to create a multitude of effects in the show. On stage, there are a total of nine units, one at the rear center of the stage, and eight others paired off with two at each front side and two at each rear side of the stage. Five more units are located at the front of the balcony. Two of these five are connected to operate in unison with the eight paired projectors on stage while the other three in the balcony are special units. Two of them are set up with rotating polarizing discs in front of them to create their special effect, while the third is equipped with a specially built dowser as the lamp is a Marc 300 arc which can not be turned on and off quickly as can the incandescent lamps used in the other projectors. (The two with the special polarizing discs use 1000-watt quartz lamps.)

A total of more than 300 slides is used during the presentation. Most of them are triggered automatically to advance continuously when their 500-watt incandescent lamps are turned on. These are used in the ten projectors which operate together. The effect they create is one of quickly changing indistinguishable shapes and patterns projected on agitatedly moving figures on stage holding a billowing scrim cloth made to blow with a wind machine. The total illusion of a storm scene is enhanced with the use of flashing bright spotlights as lightning. The zoom lenses in these projectors permits adjustment of individual image size if this is ever desired.

The two projectors with the rotating discs are used to create an undulating change of light pattern on a scrim cloth during one sequence toward the end of the show. Only one slide is used as the illusion created is that of confusion and motion due to the apparent movement of the indefinite image that is projected.

The unit at the rear center of the stage is used only once to throw a steady beam from behind the motionless Christ figure standing on stage. The shadow is cast onto a scrim cloth through which the standing figure can be seen. The slide used is a soft colored cloud effect, but that is not what the slide was made from.

The only unit projecting a definite image is the one at the center of the balcony. The slides in this projector were specially made (from original art work by designer Robin Wagner) to show a 24 ft. x 24 ft. image on the rear cyclorama of the set. The same wall is always in view and it has cut out in it a shape which has been variously described as either the Eye or Mouth of God. In order to be sure that the images projected onto the back wall would always line up perfectly with this shape in the rear wall, it was necessary to design a grid slide which was used to line up the center projector—and then this same grid was used to hand draw the slide art work so that perfect registration would result each time.

Only on rare occasion, is it necessary to line up the projector again. (As for the public in the balcony, the sound of the projector fan and slide change is lost in the sound of the show. In addition the projectors are covered to keep their source light from disturbing the audience.)

For control of the projectors, a specially designed consolette was provided. It is operated during the performance by Bill West who is highly experienced in theater audio-visuals and lighting from past association with many previous shows on Broadway. The control box, with both toggle switches and rotary controls can turn on and off the projectors which are to be operated at times called for in the staging, and can regulate the speed of lamp dimming if this is required. Indicator lamps provide visual information that the desired projector lamps are on as necessary. The control unit also allows for operation of the dowser on the Marc 300 projector. For a show which depends a great deal on its special visual effects, Mr. West and his control consolette are kept quite busy during the presentation. (One other effect projected on stage is a pattern of large dots cast by twelve spot lights with perforated masks in them.)

In the near future, there will be more and more projection required by stage shows—and this will also hold true for traveling theater companies, industrial shows and schools and colleges. Some of Broadway's effects may not be applicable or feasible but a bit of imagination can help make a client more satisfied whether the projection is on a stage, in a board room or just in a waiting room. ■

NEW PRODUCTS

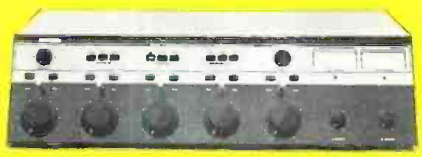
MONITOR AMPLIFIER

● Model D-150 is a dual channel power amplifier which the manufacturer offers with guaranteed minimum specifications as follows: 150 watts r.m.s. both channels at rated distortion with 8-ohm loads (typically 100 watts per channel at 8 ohms and 180 watts per channel at 4 ohms). Intermodulation distortion is less than 0.05 per cent from 0.01 watt to 75 watts. Harmonic is less than 0.05 per cent at 75 watts. Frequency response is 20-20,000 Hz ±0.1 dB. Input sensitivity for full output is 1.2 V.

Mfr: Crown International
Price: $429 rack mount ($399 without panel).
Circle 56 on Reader Service Card.

FIVE-MIXER CONSOLES

● B-500 series consoles are designed for production or subcontrol application. With all program circuitry on plug-in cards, the standard complement provides for microphone inputs to the first mixer. The remaining four mixers are equipped for 600-ohm high-level balanced inputs. Two inputs per mixer are selectable by pushbutton switching. Switching logic for speaker-muting/warning-light control at two locations is incorporated. Full cue and monitor facilities exist, with barrier type screw terminals for all connections at the rear.



Mfr: McMartin Industries
Price: $750 (mono); $1050 (stereo).
Circle 54 on Reader Service Card.

3RD GENERATION REVERBERTRON

● This artificial reverberation device is designed for livelier than ever broadcast and recorded sound. Model 659A features instant selection of three decay times. Six electro-mechanical delay lines, each isolated against building rumble and environmental noise, and each tuned differently produce a natural reverberation effect. Reduced size makes it possible for several new versions to be stacked in the space formerly occupied by one older unit. Input level requirements are also reduced to −30 dBm, and s/n is improved to 65 dB.

Mfr: Fairchild Sound
Circle 57 on Reader Service Card.

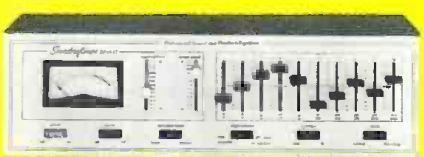
DISC CUTTER

● The 701 disc cutting system features a 500 watt continuous power amplifier that provides a cutting head capability that is flat well beyond 20 kHz being 3 dB down at 36 kHz. The amplifier incorporates protection against cutter head burnout, with all adjustments available on the front panel. A special demo record and tape are available so that the cutting studio can compare a cut made on its existing equipment with one made on this new system.
Mfr: Ortofon (Gately Electronics)
Circle 50 on Reader Service Card.

TAPE CARTRIDGE UNITS

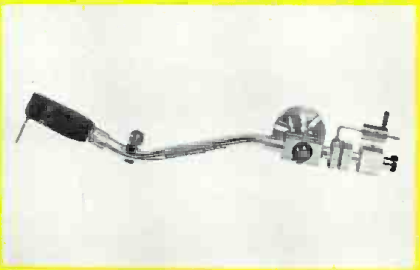
● The Century Series are completely new units that comprise a modular line of compact tape cartridge systems. Record and playback modules are the same size, three will mount side-by-side in standard racks. Single and multiple desk models are also available. There is built in audio switcher, electronics on a single plug-in circuit board, three audio inputs to the record amplifier, and optional secondary tone. Mono playback can be field-converted to stereo.
Mfr: Sparta Electronoics
Price: $430 (standard playback unit)
Circle 53 on Reader Service Card.

EQUALIZER



● Octave band equalizing can be done with this unit. It is designed to be connected between preamp and power amp in sound reinforcement application or mixer output on recording sessions. Each octave has plus or minus 12 dB control. Overall frequency response of the unit is ±0.25 dB from 20 to 20,480 Hz. Total harmonic distortion is less than 0.08 per cent at 2 V output (so is i.m. distortion). Signal-to-noise is better than 90 dB below 2 V output. Gain can be set at unity or at a maximum of 3.5 V into 600 ohms. Input impedance is 100 k ohms unbalanced with the output at 600 ohms unbalanced. Model RP10-12 is available in a walnut-grain cabinet, or for rack mount.
Mfr: Soundcraftsmen
Price: $349.50
Circle 51 on Reader Service Card

TONE ARM



● Model BE402, a twelve-inch stereo tone arm, is designed to provide optimum compliance when used with modern stereo cartridges. It is constructed of light-weight alloy and is equipped with an easily removeable cartridge head shell. Adjustments are provided for arm height and stylus force. The arm is normally supplied with a pre-wired four-foot cable assembly and will accept any cartridge conforming to EIS or JIS standards. The arm can also be furnished complete with a cartridge made by this company.
Mfr: Broadcast Electronics
Circle 58 on Reader Service Card.

BROADCAST CONSOLE

● Concept Seventy Program Logic series consoles for the broadcaster have noise from attenuation but additionally provide logic circuitry which allows instantaneous programming of automated segues and clusters on a random-bus basis. Conceived for personality combo operations, it provides greater programming tightness and flexibility by automating back to back segues, while maintaining full freedom and instantaneous programming changes. Mono, stereo, and four-channel versions are available.
Mfr: Broadcast Recorders
Circle 52 on Reader Service Card.

FAIRCHILD
SOUND EQUIPMENT CORP.
ENGINEERING DATA

PORTABLE MIXING CONSOLES

ROBINS INDUSTRIES CORP. SUBSIDIARY
15-58 127TH ST. FLUSHING, NEW YORK 11356 212 445-7200

MODEL	INPUTS & OUTPUTS
FPC-26	Eight inputs — two outputs
FPC-28	Eight inputs — four outputs
FPC-30	Twelve inputs — two outputs
FPC-32	Eight inputs — eight outputs
FPC-34	Twelve inputs — four outputs
FPC-36	Twelve inputs — eight outputs
FPC-38	Sixteen inputs — two outputs
FPC-42	Sixteen inputs — four outputs
FPC-50	Sixteen inputs — eight outputs

The FPC portable consoles are the first and only truly portable professional multi-channel mixing and sound shaping consoles. Using the latest reliable field-tested solid state circuitry, the FPC series can accomplish, on location or in the studio, almost anything that a large console can do.

These completely self-contained units are designed to be used in the field for recording, broadcast remotes and sound reinforcement. They are designed for ruggedness, high performance and low cost.

- Only 28" x 24" x 2" and weighing only 30 to 45 lbs. (depending on model).
- Up to 16 inputs and up to 8 outputs (50 individual amplifier circuits).
- Can operate for 25 hours on one set of "C" batteries in armrest (or use external power supply).
- Constructed of solid aluminum for ruggedness and light weight, and finished in walnut grain Formica with lettering engraved for lifetime no-wear use.
- VU meter panel tilts up for easy on-location monitoring.
- Comfortably padded Naugahyde armrest pulls forward for access to the XLR input, output and power connectors.
- Each output channel and power supply is metered.
- Failsafe automatic emergency battery power in case of supply failure.
- Automatic polarity protection for power input.

INPUTS Up to 16 balanced, transformer isolated inputs have input level switches which accommodate levels from microphone to line in 5 ranges. Impedance range from 200 ohms to bridging for high level inputs. Each input channel has a preamplifier, boost amplifier and input fader.

EQUALIZATION Each channel has full range equalization with independent low frequency boost and droop control, high frequency boost and roll-off control, and selectable peaking point control.

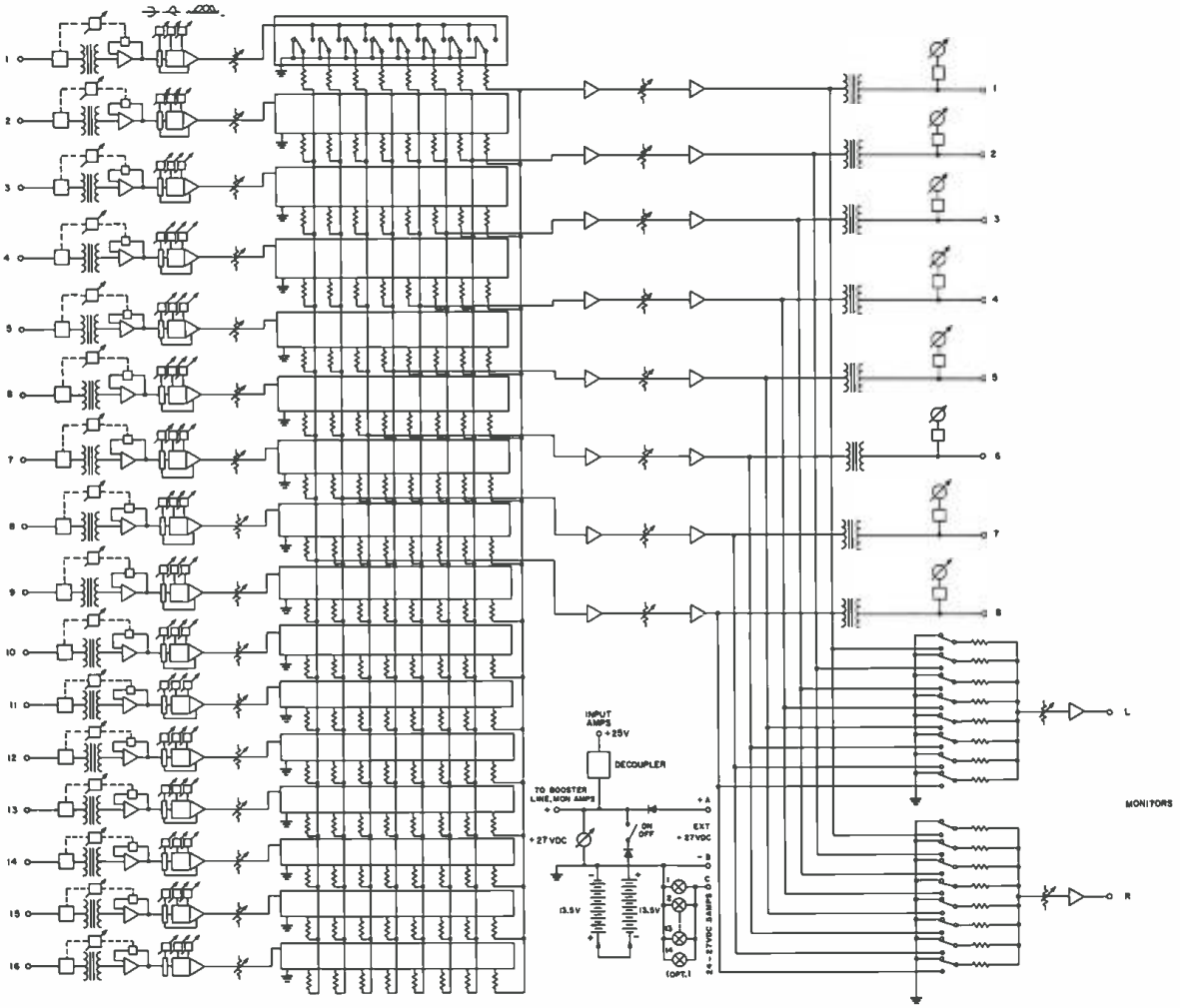
OUTPUTS Up to 8 mixing networks process signals into 8 separate transformer isolated output channels, each with submaster slide faders, taut band VU meters, booster amplifiers, line amplifiers, and balanced output transformer.

FAIRCHILD ENGINEERING DATA
PORTABLE MIXING CONSOLES

DELEGATION The mixing circuits of the FPC allow the signal from any input channel to be delegated to one, several or all output channels simultaneously. Signals from any input can also be delegated into these channels for external distribution for echo, reverberation or other special effect, or monitoring.

MONITORING Two adjustable monitor channels are provided with capability of monitoring one, several or all output channels simultaneously. Stereo phone jack is provided.

POWER SUPPLY Operates from self-contained power pack (18 "C" cells), or any external power supply, 27VDC @ 150 ma. max. FAIRCHILD 667AA/27 power supply is recommended. The FPC has battery ON/OFF switch and power meter. Fail-safe circuit automatically turns batteries on in case of external power failure. Diode in power circuit protects unit against reversed polarity.



FAIRCHILD PORTABLE MIXER MODEL FPC 50

SPECIFICATIONS

GAIN	90 db
INPUT LEVELS	—55, —40, —30, —20, +4 dbm
OUTPUT LEVELS	+4 dbm nominal (14 db headroom)
INPUT IMPEDANCE	200 ohms for mic input, bridging for line level
OUTPUT IMPEDANCE	50 ohms designed for loads 150 ohms or higher
EQUALIZER	±15 db control of complete spectrum in 3 db steps with boost frequencies of 2, 3, 4, 7 and 10 kHz
DISTORTION	0.3% THD max (all 50 amplifiers)
FREQUENCY RESPONSE	±0.5 db 20-20 kHz
INPUT NOISE	—125 dbm
INTERCHANNEL SEPARATION	70 db min
POWER CONSUMPTION	0.15 amperes at 27 volts
BATTERIES	18 — alkaline or ordinary flashlight "C" type
DIMENSIONS	28" x 24" x 2"
WEIGHT	30 to 45 lbs complete
FRAME CONSTRUCTION	All aluminum, covered with engraved Formica, walnut grain.

FAIRCHILD
SOUND EQUIPMENT CORP.
A ROBINS INDUSTRIES CORP. SUBSIDIARY
15-58 127TH ST. FLUSHING, NEW YORK 11356 212 445-7200

WILLIAM MATTHEUS

The Taming of Maxwell Hall

The problem was "how to get intelligible sound in a twenty million cubic foot reverberation chamber." Huge halls call for unique solutions to sound reinforcement needs.

DON MAXWELL HALL in Chicago's lakefront McCormick Place, we have been told, is the second largest indoor arena in the country, being exceeded in volume only by Houston's mammoth Astrodome. This arena, reborn from the ashes of the 1967 fire which razed the original McCormick Place, had been in use for only five months, but it had already incurred a reputation for unhappy acoustics. As one listener put it, "After a few minutes, the sound rolls around somewhere overhead, and then all you can hear is mumbo-jumbo."

The Billy Graham Crusade was returning to McCormick Place nine years after an initial visit, and intelligible sound reinforcement was essential for the success of the Crusade. Armed with a given nine second mid-range reverberation time for the Hall, our company was requested to design a sound system for the huge arena. Only a decade ago, we would have probably debated whether such a system was possible, but sound-system techniques and design had come a long way in the past few years and we were approaching the challenge with optimism.

Our first task was to determine just how far we could expect our loudspeakers to project sound with good intelligibility. A distributed loudspeaker system was out of the question due to the limited time we had to install all equipment. Therefore, a point source loudspeaker array was the only sensible alternative.

To find the *critical distance* which was how far our loudspeakers would project until the direct sound equalled the reverberated sound we had to know three things: First, the arena surface area in square feet; second, the Q of the loudspeaker array; and third, the average absorption coefficient of the arena's surface area. The total surface area was 961,200 square feet; the loudspeaker estimated Q was 7; and using the formulas $\bar{a} = \frac{a}{S}$ and $T_{60} = \frac{0.049\ V}{a}$ sec. we arrived at 0.112 for the average absorption coefficient where V = 19,656,000 cu. ft. Our Dc or critical distance, then, by the formula $Dc = 0.14\sqrt{QS\bar{a}}$ equalled 121 feet with the room empty. With a minimum estimated crowd of 17,500 adding 4 sabins per person, and again using the same formulas we found our Dc to be 151 feet. Since our design data indicated that our loudspeakers could reach as far as 4 Dc with acceptable intelligibility, our maximum sound penetration would be 604 feet.

Because of past experience with reverberent areas, we suspected that the 604 foot figure was misleading. Coupled to the fact that a single point source loudspeaker array wouldn't deliver the sound pressure level we desired, we decided to install four satellite loudspeaker clusters and to feed them with a 155 millisecond delayed signal so that they would be in time phase with the sound coming from the main loudspeaker array.

The program origination for the Crusade was 140 feet from the east side of the arena and centered in the north-south direction. From this position there was a maximum throw of 425 feet to the farthest seat from the podium. Our four satellite loudspeakers on a 175 foot radius from the central cluster would cover the north and south far areas, while the north and south near areas as well as the near and far west areas would be covered by the main loudspeaker cluster. Our farthest projection from any loudspeaker would be 325 feet, well within our calculated Dc limit.

Our satellite loudspeaker arrays consisted of Altec-Lansing multi-cellular horns, a 500-Hz crossover network, and a 15-inch Altec-Lansing low-frequency loudspeaker mounted in a six cubic-foot front-and-rear-loading type housing. Our central cluster consisted of a combination of eight multi-cellular and sectoral horns; two 500-Hz crossover networks and two columns of a stack of three of the low-frequency enclosures referred to above. The loudspeakers were powered by seven Altec-Lansing solid-state amplifiers providing 1000 watts of audio power.

For our delayed circuits, we used a 10-bit digital electronic delay having a 62 dB dynamic range as supplied by The Industrial Research Corp. of Elk Grove Village, Ill. Since this was our first experience with such a unit, we had an Ampex tape machine as a back-up, but we could have spared ourselves the trouble. The digital delay worked perfectly, and we are indeed grateful to Industrial Research for their fine cooperation in providing it.

In addition to the main arena coverage, we designed a separate sound system for the 2,000-voice choir using two Altec-Lansing 605B loudspeakers in the previously described 6 cu. ft. housings. These were hung from the 50 ft. high horizontal beams above the choir on quarter-point centers to provide complete coverage.

We began work on Tuesday, June 1st, and after two and one half days of almost around the clock effort we turned on the main sound system and made preliminary tests. The room was empty except for workmen and officials, but we knew after a few minutes that this was cer-

Figure 1. Maxwell Hall filled with people there for Billy Graham's Crusade. A hanging cluster of horns can just be seen.

tainly the most reverberant room we have ever head. The sound would indeed, on the far areas of coverage "roll around and get lost somewhere up above."

Using our audio real-time spectrum analyzer we custom-equalized the system using Altec-Lansing 1/3rd octave Acousta-Voice filters. This helped improve intelligibility considerably. We wanted to make further tests, but time had run out, as Cliff Barrows (the director) was beginning to rehearse the choir for the first performance.

Twenty-two thousand people arrived the first night and added their much-needed sabins to the over-all acoustical absorbency. We walked the huge area in two-way communication with our operator and it was soon apparent that either our given reverberation time was greater than 9.0 seconds, or else we had made an error in our calculations and conclusions. For the most part, the inner areas of coverage were acceptable, but the far areas were poor. Fortunately, most of the relatively small crowd sat up close, and we had only a few complaints. The next day was spent rechecking impedances and circuitry and in re-equalizing the system, taking out more feedback modes.

Twenty-eight thousand people attended the Crusade the second night and even though we had made some improvement, our perimeter coverage was still not good. At this time we suspected that the very-low-frequency reverberation was much longer than anticipated. As is customary, all of our measursements and calculations had been made using the mid-range reverberation time. With this in mind we rolled off the low end response at 150 Hz with an 18 dB-per-octave filter.

The following day we added another delayed loudspeaker cluster and two sectoral horns on the west side of the Hall. This solved the problem in that area, but after the third night of the Crusade, at which thirty-thousand people attended, we decided that two more north-south sectoral horns would be required. These were installed the morning of the fourth day and connected to a separate 65 milli-second tap on the electronic delay.

With the added interim coverage it was then possible to boost the entire perimeter levels, and on the fourth day of the Crusade (Sunday afternoon) we had our first really good sound in the arena. A compressor was added the next day for a small amount of compression to subdue high sound peak levels, was the final step in our fight against the acoustics of Maxwell Hall. From then on we had good sound throughout the area and complaints faded away.

Needless to say, we had received all sorts of advice and information during our operations, some of it not exactly complimentary. The information, however, which gave us the most help and verified our suspicions as to acoustic absorbency was supplied by Peter Tappan, an acoustical consultant for Bolt, Beranek and Newman. He had made a recording of the sound on the third night's performance at which thirty thousand people were present. An analysis later revealed that the mid-range reverberation time that night with that crowd was 6.5 seconds. Figuring 4.0 sabins per person, then with 120,000 added sabins we calculated the empty acoustical absorbency of the Hall. Again using the formula $T60 = \frac{0.049V}{-a}$ sec., we found that 148,176 sabins are required for a reverberation time of 6.5 seconds in an area the size of Maxwell Hall. Subtracting the crowd absorbency from this figure leaves only 28,176 sabins for the Hall empty. Our average absorbency coefficient then, would be only 0.037 instead of 0.111 and our Dc or critical distance, 64 ft.. instead of 121 ft. Four times 64 ft. is only 256 ft. which matched fairly closely the practical limit of our loudspeaker projection at Maxwell Hall with an empty house.

On the closing day of the Crusade we were pleased to hear Dr. Graham say that the sound had been very good. It is gratifying indeed to know that with proper techniques and equipment that even a "20 million cubic foot reverberation chamber" can be provided with good sound reinforcement. ■

WILLIAM L. KAFFENBERGER

Non-Standard Mic Techniques

The audio engineer in the theater is often called on to test his ingenuity when short notice and no money combine with an unusual performance wiih special requirements.

A FAR TOO USUAL procedure for productions in presentational houses, be they school, community, or unfortunately even professional, is to bring the audio problems of a production to the engineer only after blocking and sets are established. This condition is often further aggravated by tight schedules and overlapping events, which prohibit further changes of any appreciable benefit to the audio engineer. The situation here at Evanston Township High School falls well within these parameters. As an example, the weeks prior to Christmas find our fifteen-hundred seat main auditorium scheduled for two choral concerts, an Evanston Symphony concert, two performances of *Amahl and the Night Visitors* (each with a different cast), and the regularly scheduled stagecraft and acting classes.

From the floor plan, one can see that to accommodate a ninety member symphony and choral risers as well, the main stage and side mini stages need to be used. The set for Amahl therefore had to be placed on the movable forestage and constructed on wagons to allow for its movement to side areas during the other concerts. For the Amahl production, this meant that the orchestra was placed directly behind the singers on the main stage riser setup. This arrangement is hardly ideal for electronic reinforcement of the vocalists, since (the orchestra being behind the singers) microphones located in a more usual position in front of the singers would have provided reinforcement for the instrumentalists as well as the vocalists. To further complicate conditions, the set placement moved the areas to be reinforced out in front of the permanently-mounted house speakers. Although, feedback/usable gain has been greatly improved by modern techniques, but the presumption is of stationary microphones. Obviously the requirements for a presentational house would mean "tuning" for each production, a process not financially possible for many managements!

For the sake of fairness to the cast, *Amahl and the Night Visitors* presented in live performance, constitutes an adaptation in that the opera was commissioned by the NBC-TV Opera Workshop specifically for television. Menotti's realization of the orchestral score, and the sensitive balances with the vocal parts, especially for the young boy, were conceived with the knowledge of proper levels being maintained by the audio engineer. Just so, it should be anticipated that sitting in the house for the first orchestra and cast rehearsal would be an aural nightmare, which because of the composition's originally intended medium, could not be faulted to the cast. Amahl's mother could be heard perhaps half of the time, the three kings were seldom heard, and Amahl was only heard when there was no orchestral accompaniment. With the production having been double cast, this rehearsal as it sounded was all the more disastrous in that I was hearing the vocally strong cast!

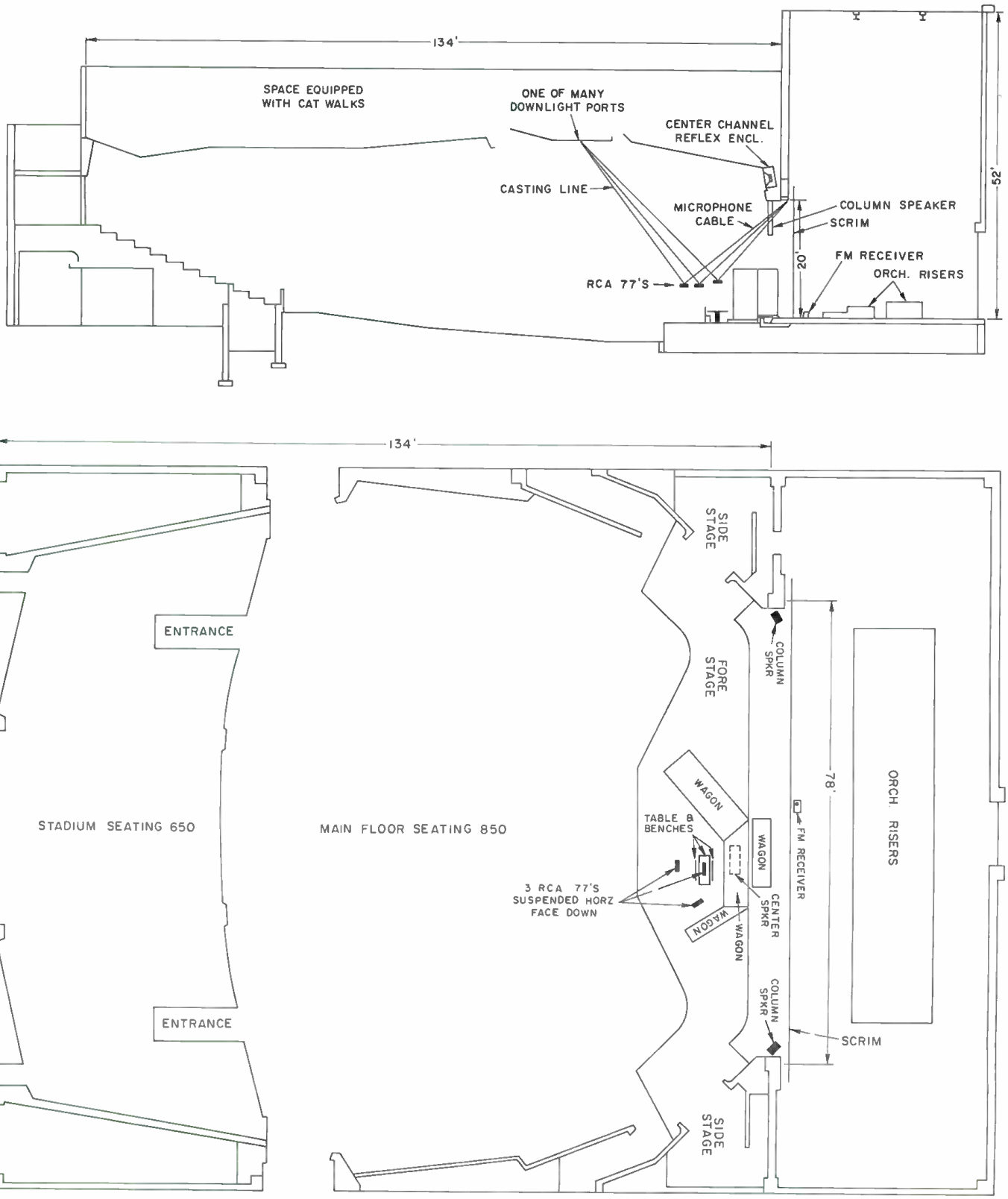
In the remaining time of several days, with the heavy rehearsal schedules of the house, the suspension of a half dozen or so microphones over the entire acting area was impossible. So, relatively standard techniques held little hope for this show. One approach seemed to offer a partial remedy, viz. the use of an f.m. microphone for Amahl. However, there still was the need to cover those cast members not close enough to Amahl to benefit from his microphone. I feared that most of the standard approaches would pick up the orchestra as well, and that the placement of acting areas in front of the speakers precluded a frontal pickup. I recalled some techniques that had been investigated by engineers from Shure Brothers over the past few months here (see **db, April, 1971**). Our house, being fairly well designed, and close at hand to their corporate headquarters, had been used to test some microphone placements and supports for reflective pickups. It occurred to me that an adaptation of that technique might help.

Three principle areas of the set were established as shown by the microphone symbols on the floor plan. RCA 77DX's were sling-supported with one for each of the areas. This involved using the microphone cable as one half of the *Y* running to the rear edge of the grand teaser which is backed with wood as shown in the elevation sketch. The other half of the *Y* was braided nylon fish-casting line (20 lb. test, black) which is almost invisible. The ceiling construction with removable downlights allows a choice of positions to get the correct angle for microphone placement. Once in place, the unidirectional pattern setting was used with the angle of incidence being perpendicular to the floor plane. In spite of a canvas ground cloth covering, it was hoped that the hard wood flooring

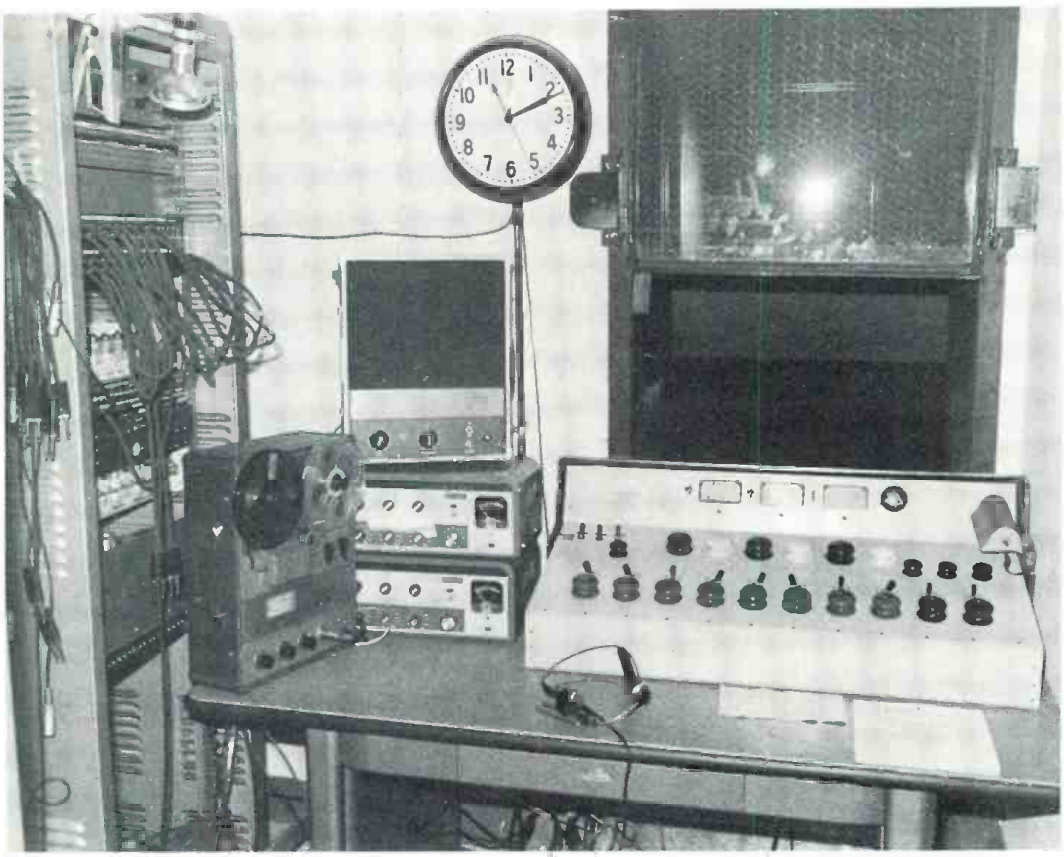
Mr. Kaffenberger, a musician, and audio engineer, is one of the media engineers at Evanston Township (Illinois) High School.

underneath would provide sufficient reflection of the singing voice while the plane of the microphone discriminated against the orchestral energy, thereby providing the much needed selective reinforcement.

Full use of this setup was limited to dress rehearsals and performance, and time constraints did not permit any major modifications of placement. The entire production was covered with four microphones. Before I had a chance to run this setup, the musical director thought it still might be necessary to bring in all the stage drapes to help reduce the volume of the instrumentalists who were placed on the main stage behind a scrim. In this event, as a precaution, I had set up two additional 77's for the orchestra, *not* for volume, but rather to add the higher frequencies



Architectural floor plans of the auditorium showing the mic placements.



The control panel at Evanston Township High.

which would have been lost in the drapes. This was not necessary. In fact, the vocal microphones worked so well, I was able to tell the conductor not to hold the orchestra back at all.

The four microphones that I did use fed directly into the house system, which is a three-channel Langevin board with eight low-level and two high-level inputs. These inputs are augmented as need arises with two Knight 3060HD amplifiers serving, with dummy loads, as eight additional microphone preamps. The entire system is cross patchable and feeds three 75-watt McIntosh power amplifiers which are also patched for one of the following modes: mono, two-channel, or three-channel stereo operation. Our present microphone compliment includes: nine RCA 77DX's, four RCA BK-5B's, four RCA BK-6B's, eight EV 664's, and two Sony C-37A's. The f.m. microphone, an Edcore Sensapak model SP-2 equipped with a model SM-2 Sensamike, was rented for this occasion and proved to be flawless in this application. I might advise, however, that it was necessary to operate the f.m. receiver on its internal battery pack because of a.c. line noise generated by our two-scene preset thyratron lighting board. The receiver was placed directly behind the center of the set with a line transformer plugging into one of the center stage microphone lines.

The techniques employed were eminently successful in that: first, all the voices as well as Amahl's very small speaking voice were heard well, and secondly, many nuances such as the gentle kiss of Amahl's mother carried in good aural perspective. It was also interesting to note that even when singers were situated in front of the 77's, they still benefited by the reflected pickup—an unanticipated boon. What had started as an impossible situation proved, in performance, to leave nothing wanting. ■

ROBERT HAWKINS

For a Dime and a Boxtop

Return with us to the early days of radio and re-live—if you were there—those times when the great crisis of life was waiting for the mail to bring what the boxtop was sent for.

IT WAS LIKE STEPPING into a time machine. One minute sitting in the living room, having popcorn with the kids, listening to old radio tapes; the next minute catapulted, mind over memory, back almost forty years in time.

We'd been relaxing in front of the speakers, listening to a new reel of old-time radio tapes from a fellow collector back east, when the network announcer's mellow tones urged, "Stay tuned next for the Adventures of Little Orphan Annie!"

That was all, but suddenly I could picture myself back in the early thirties, rushing home from school, letting the screen door slam, turning on the tall mahogany console, stirring the crunchy Ovaltine around in the big brown Little Orphan Annie Shake Up Mug.

The next day mentioning it to friends at work, brought forth a similar reaction from them and a general agreement that the old Orphan Annie mug must have been the very first one of those things around. As it turns out, it wasn't, although it was probably the most familiar ever produced. The things were known in the trade as *radio premiums*. To your folks they may have been junk, to you they were treasure, but to the toddling radio industry they were vast new opportunities in advertising.

The whole thing started by accident on the eve of another interesting radio event, the first dance-band remote. WJZ, a small Westinghouse station in Albany, New York, had set up a one-mic remote pickup to bring, for the first time ever, *live* dance music to their audiences. The time was the Thursday just before Christmas in 1921. The band was Vincent Lopez, the locale was the Pennsylvania Grill of the Statler Hotel in New York City and the lines were installed, after a month of study, by Western Union, after the telephone company had said it wasn't feasible.

Listeners had been encouraged to come down and watch an *actual broadcast* and the invitation proved so irresistable, every table in the room was reserved almost immediately. On the night of the broadcast, the entire hotel had been sold out and the surrounding streets were packed. The Lopez show, that night, was a great success but the bandleader still felt guilty because so many had been turned away. At the end of the broadcast, he stepped to the carbon microphone and generously offered a photograph of himself to anyone who would write in. The next day's mail filled ten huge clothes hampers, and the station couldn't handle it. Lopez apologized on the air and changed the offer, suggesting that anyone who would phone the hotel would get a picture. The flood of calls jammed the hotel's switchboard and knocked out one of Manhattan's main telephone exchanges.

Just about a year later, on December 30, 1922, AT&T's innovative station WEAF in New York, tried the same gimmick in their first hesitant attempts (horrors) *advertising* on the *radio!* An agency head went on the air himself with a ten-minute speil on (guess what?) *Advertising* and concluded by offering free copies of his speech. In the second recorded mail pull in broadcasting history, the station got ten phone calls and fifteen cards and letters, including one from a cosmetics firm named Mineralava. By January of the next year, the adman had them on the air too with a talk by film star Marion Davies on *How I Make up for the Movies,* which ended with an offer of a free, autographed picture of the actress. The station's mail jumped immediately from a handful of letters into the hundreds.

In the few years that followed, free glossy photographs continued as the main bill of fare in the premium line, (by 1929, Amos 'n Andy had given out over 200,000 of them), but soon, larger advertisers and early networks began to discern the attraction and result of a *premium* offer, and some interesting ones blossomed.

In 1930, a toothpaste-sponsored astrology series asked listeners to send in a boxtop, their birthdate and a letter about personal problems and they would be answered on the air. Over at WMCA, New York, you could get a *Balkin Success Chart* in exchange for a boxtop, and in Newark, 2,000 people a day were getting their palm read via WOR's new series on palmistry. One of the strangest of all, though, was *The Voice of Experience,* a startling human relations advice program on the early CBS network which drew up to 20,000 letters per week, read the most salacious ones on the air and answered the rest with one of several dozen form letters. No matter, though, for by this time, various sponsors across the country were tuning in to radio giveaways and many reported sales up "several hundred percent," and by 1932, merchandising schemes of all sorts were on the air.

Programming, too, was becoming more varied. Across the country, children's shows were becoming increasingly popular and, one of the best of them *The Singing Lady,* as portrayed by Irene Wicker on WGN, Chicago, was sponsored by the Kellogg Company. When they offered the kids her *Singing Lady Songbook,* the boxtop barrage hit 13,000 a day. An agency vice-president gleefully announced Kellogg's Battle Creek plant had thirty-eight women devoting full time to answering the nearly 100,000 letters weekly, and that "people are eating more Kellogg cereals than ever before."

Maybe this was what marked the beginning of the golden era of gold plated premiums. About this time, the Wander Company of Chicago, makers of Ovaltine, were on the air with a new type of dramatized children's show based on the syndicated comic-strip *Little Orphan Annie.* To help promote it, they were looking for some kind of a sales inducement that might be attractive to small fry. As a trial, they cautiously announced the offer of a free picture of the famous funny-paper heroine in exchange for the little folder on the back of the Ovaltine can. They were overwhelmed. Back came 418,000 replies and the message

The flotsam of a forgotten age. How many do you know? Left to right back row: an early Tom Mix magazine ad plugging their boxtop premiums and radio shows, and a copy of the official Little Orphan Annie theme song. The middle row: plastic Ovaltine Annie mug, early pottery mug, shake-up or cold mug with lid, and later plastic mug. In the front row: a junior pilot ring from American Airlines, Captain Midnight's Flight Commander code ring, Tom Mix Magic Cat's Eye Ring with glow in the dark eye and a sliding compartment, a Lone Ranger (Hi Yo Silver) silver bullet with a secret compartment—loaded with energy (?) pill and a built-in compass, the Flashlight Ring, the Tom Mix lookaround or periscope ring, and a secret club ring set with litmus paper and a plastic stone.

was clear. You could sell more product to the adults by selling the kids and the way to do that was by offering "free" premiums requiring purchase of the product. The kids show phenomenon was a marriage made in Heaven—revenue plus ratings.

Little Orphan Annie, a dramatization of the famous Harold Gray strip, was one of the best of the genre. Beginning in 1930, it featured Shirley Bell as Annie, newsreel voice Pierre Andre as the announcer and the voice of Sandy, Stanley Andrews (later to be the old ranger on t.v.'s *Death Valley Days*) was Daddy Warbucks, and Annie's friend, Joe Corntassel, was young Mel Torme. The shows were all written and produced by Ovaltine's advertising agency who, knowing a good thing, began to work a series of glorious premiums right into the plotlines.

The free picture offer was followed by a cutout face mask of the little red-haired waif but now you had to produce a dime and the inner tinfoil seal from the product. As Annie's popularity mounted, so did the variety of her giveaways. Before she left the air in 1940, the "little chatterbox with the pretty auburn locks" gave out hundreds of thousands of items: Little Orphan Annie pins and buttons, Secret Society badges and decoders (six varieties), special code cards and manuals, two kinds of bracelets, and the ever-popular Ovaltine mug.

Shades of the Dragon Lady! A Terry and the Pirates Gold Detector ring.

The mugs, out in 1936, developed into two styles: the cold shake-up tumbler mug and the hot mug. The first was a regulation pottery mug with full color drawings on both sides, followed by two similar ones with single drawings, made of a brown plastic called Beetleware, and finally, two slightly taller *Shake-up* mugs, omplete with the embossed red-lettered lids. Each of these mugs had a different cartoon on the front with a smiling Sandy saying "Arf!". A veteran premium company, Kurz-Kasch, Inc. of Dayton, Ohio, still in business today, moulded, assembled and shipped both styles of plastic mugs. From 1932 to 1940, they mailed out 5,250,000 of the *Shake-up* tumblers and 3,600,000 of the hot mugs with the handle. From an original cost of a dime and a boxtop, these bits of radio nostalgia have risen today to the neighborhood of thirty to fifty dollars each.

As the ageless orphan's popularity began to spread, predictably, other comic strip characters began to be heard: Skeezix of Gasoline Alley, Andy Gump, Tarzan, Terry and the Pirates, and Dick Tracy. Even Buck Rogers returned "from the Twenty-fifth Century A.D.", but although most of the funny-paper shows were popular, none ever reached the burning zenith of national hero-worship as did two other gentlemen from other media . . . Tom Mix from the movies and Jack Armstrong, an original product of radio, itself.

Even though Tarzan and Buck Rogers had a two-year lead on them, when the All American boy and the Old Straight Shooter hit the air in 1933, they immediately attracted a following that grew to true nationwide proportions.

Jack Armstrong was the brainchild of Frank Hummert, the producer and advertising executive who became famous for such network soap operas as *Just Plain Bill*. He gave the script-writing assignment to Robert Hardy Andrews, who was once the voice of *The Shadow*, who had created the redoubtable *Ma Perkins* and who, in 1929, had invented the forerunner of all the Jack Armstrong mystique in a kid's radio show called *Skippy*. Also based on an early comic-strip, this one introduced the "Radio Secret Society" club, complete with a secret code book and handshake.

During his audio lifespan of 18 years, Jack was played by a variety of actors, with the most notable being Jim Ameche. At various times, other cast members included the late movie star, Paul Douglas, the show's first announcer, Tyrone Power, who did bit parts, and Dick York, star of t.v.'s *Bewitched*, who was cast in the perenially apologetic role of the hero's kid sidekick, Billy.

Like many of the other radio heros, Jack held a fondness for rings and, over the years, offered his fans a number of them. The first was the plastic ring that glowed in the dark. (Buck Rogers also had one something like that, but his would only glow if held by an Earthman. It was a good test for visiting Venusians.) The Hudson High hero followed up his glowing ring success with his whistle ring, which really worked, and came with a code chart of what various whistled signals meant, the most unlikely of which was four whistles which meant "We're being watched!" Although he later gave out a Jack Armstrong flashlight, a cardboard *chart* game, a magnesium parachute ball and his famous *Hike O Meter*, his most popular preminum was the Jack Armstrong Secret Bobsight, (the one the enemy would give anything to have.) Wheaties sent out hundreds of thousands of these little four inch cardboard and mirrored devices, which would actually drop cardboard bombs on a cardboard enemy fleet. You supplied your own sound effects.

When Tom Mix thundered into the nation's loudspeakers for the first time, he already had a small advantage over his peers in the form of some 180 feature films behind him. His agent and merchandising experts were a canny lot and already the owner of Tony, the Wonder Horse was raking in fees for everything from Tom Mix clothing royalties to Big Little Books. Strangely, Mix himself never appeared on the show, preferring to make more money with his touring rodeo. During those years, various actors played the lead but the supporting players were always outstanding. Tom's pal, Sheriff Mike Shaw, was played for a long while by Hal Peary, later to star in *The Great Gildersleeve,* and Tom's young ward, Jimmy, was performed by a kid named George Gobel.

If Jack Armstrong had a small liking for rings, Tom Mix was possessed by them. No one could ever calculate how much Ralston cereal was manfully swallowed by how many of America's kids in order to qualify for a Tom Mix Magnet Ring, a Ralston Straight-Shooter's ring, a Lookaround Ring (something like a periscope with crossed six-guns on the front) or his Photo ring, with Tom's picture inside. Tom also sent out a lot of Lucky Horseshoe Nail rings, as well as the Magic Cat's Eye Ring and two kinds of Whistle rings, one with stars and holes in the front and the other a slide whistle affair. He mailed out at least one variety of Tom Mix button and three different badges and club pins, one an early *decoder.* Over the years, he also generously provided a battery-powered telegraph in three models, a set of multitoned pipes, a three-color flashlight, a penlight, a brass compass with magnifying glass, a "smallifying" glass, a pocket knife and two wooden six-shooters. The latter were black and crudely carved by today's standards, but they were "just like Tom wears on his hip."

Probably Tom's best kown gift premium, though, was a simple little pamphlet, *The Life of Tom Mix and the Straight-Shooter's Manual,* which went out by the tens of thousands. The show finally offered what one historian called "The Saddest radio Premium of All" in the form of the *Tom Mix TV Set,* which featured pictures of the cast, in a film strip form. Its introduction, in an informal way, signalled the end of adventure and imagination, as the young radio fans of the country knew them, but admitting that television was an upcoming medium of entertainment.

There were other radio premiums that were memorable fun, though, in the roughly twenty years of the gold-plated premium era. Captain Midnight was very big on decoders, and his *Code O Graph,* introduced in 1942, subsequently had four other models. The big thing about the Captain was that he used his decoder every day, and woe unto you if you weren't right there with a pencil to catch the secret message, direct from him to you, that ended every broadcast. Cap's first C-O-G contained a photo of the leader complete with goggles and leather helmet. Probably due to the wartime scarcity of metals, the next model didn't appear till 1946, but it was a beauty; a gold shield badge affair and a mirror, suitable for flashing messages, which probably drove low-flying airline pilots batty. A later version contained a police-type whistle, and the 1948 model featured one of the premium world's first "secret compartments," so handy for hiding crib notes on multiplication tables. The little red-haired girl with the blanked-out eyes, Orphan Annie, had a thing for decoders too, and passed them out steadily to her Secret Society members from 1936 to 1940.

Most of the badge and ring premiums were made by the Robbins Company, a jewelry designer and manufacturer in Massachusetts. They produced the Atom Bomb Ring, the Flashlight Ring, the Lookaround Ring and dozens of others, and estimate that during the peak of the premium

Do you remember the day the mailman delivered the heavy brown envelope? Inside was your brand-new 1946 Captain Midnight Code-O-Graph secret decoder.

age, between 1930 and 1940, they produced over *ten million* of the self-sustaining badges, decoders, rings and pins.

The other popular premiums, now long since forgotten were items of almost every type and style. Usually, they had only one thing in common: they had to be easily mailable. There were signallers and weapons, clothing and jewelry—each somehow tied in with the hero or the name of his radio program. My own research shows a total of close to 150 different items, from the smallest, (a Tom Mix Watch Fob "with gold ore encased") to the largest, (a Little Orphan Annie Airplane Cockpit), from the lightest in weight, (a Superman of America Certificate . . . Mix Watch Fob "with gold ore encased") to the largest, (a set of Tom Mix spurs, with "light-charged star-spinners.")

Why do people collect these things? What makes them go to the trouble and expense? What is it about a penny's worth of plated pot-metal that makes it something people smile at, and tuck away? For some, it's simply knowing you've got something sought after—something at the moment no one else has. For others, premiums are the artifacts of an historic era, with each item another block in the giant monument that was Radio Drama.

And why am I interested in them? A little bit of all these reasons, I guess, and maybe a couple of more. They represent the happy times. The growing up years. They are memories you can hold in your hand, of a special time when excitement *was* truly almost breathless. They represent a time when life was good, and every new day had a kind of a special flavor, and the world was a whole lot simpler. They say everyone wants to "go back again", and if that's true, this is one of the times I'd like to run through again, this time a little slower, if you don't mind. It represents a time when the worst problem of the day was finding a stub of a pencil to take down the "special messages in *secret code,*" and the best thing that could happen to you might be racing home after school on a sunny fall day, and finding something waiting for you on the hall table. A fat brown envelope with a silver clasp on the back. Heavy to the touch and addressed to you by a mysterious, unfamiliar hand. The deep black ink on the postmark is a little smeared but you can just make out *Battle Creek, Michigan* and you know it's finally arrived! Your very own, after weeks and weeks, and just think—you got it for just a dime and a boxtop! ■

We admit...
we have created a generation gap!

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We have to, because we insist on staying far ahead.

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MICROPHONES • HEADPHONES

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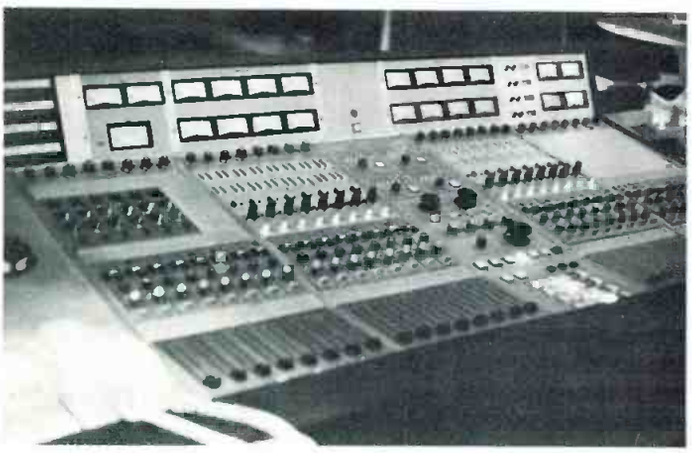
AKG-17

db Visits—Manta Sound

Manta Sound. In many ways the building is much too pretty for the city surroundings it must share. It's located at 311 Adelaide St., E., in Toronto. The main entrance into a handsome lobby is at the extreme left.



The main (large) studio is served by a custom console that was assembled during the latter part of the building's construction and then moved in. There are 32 input channels and 16 out.

The other control room has a (more or less) stock Neve console that was installed with a great rapidity and without a hitch. It has 16 channels in, and as many out, and is currently being modified.

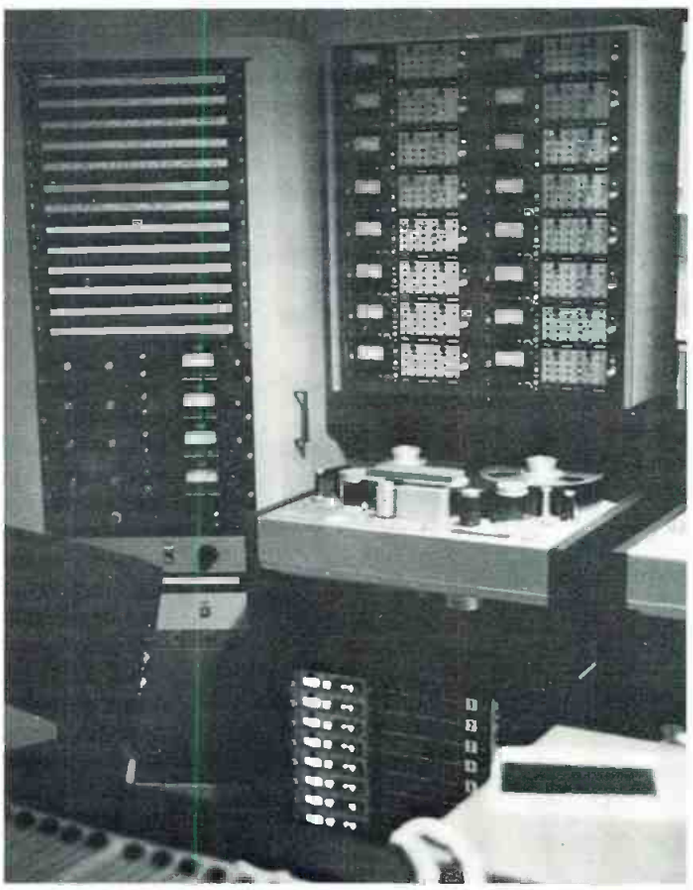
TORONTO IS A BEAUTIFUL CITY and a thoroughly modern one. In common with so much of Canada, it has both the patina of age, and the newest of the new. One of the newest of the new is Manta Sound, a recording studio complex set up in a brand-new custom-built building, right in the heart of Toronto.

The building rose from the ground slowly, starting in 1970, and finishing almost a year later. The official opening was November 4th, 1971. Our camera was there.

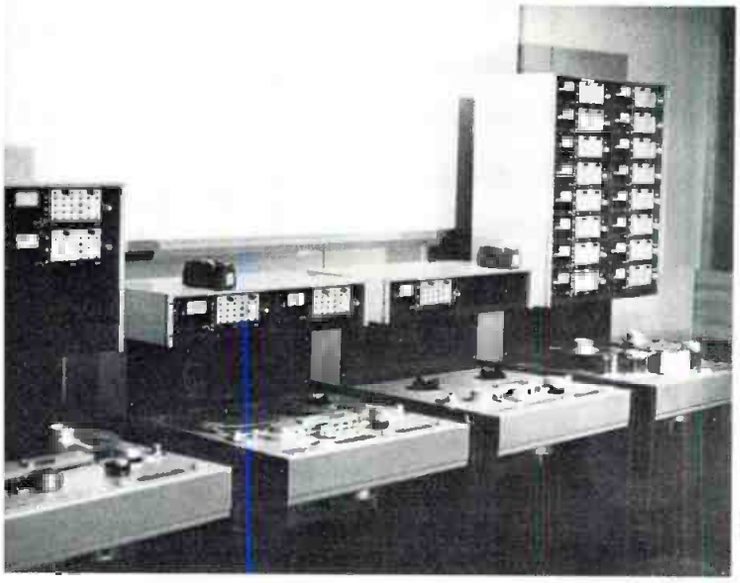
The studio group itself has both large and small rooms. The large main studio is fit for a small symphony orchestra or large rock group. The main small studio is still large enough for an average group. Each studio has its own control room and machines so that a lot of recording can go on at one time.

Manta Sound does about 70 per cent of its business in taping for record release. The next 25 per cent is occupied with commercials, with the remaining 5 per cent used to record film scores. The studios are kept busy.

We were both invited and hosted by chief engineer David Greene who introduced us to the principals and other key people of the studio. Andy Hermant is president, Doug Elphick is studio manager, Brian Lowe is technical manager, and Lee DeCarlo is a senior engineer.



One of the 16-track Studer machines. The two 16-track units are convertible to 8-track. Dolby boxes can be seen below; a patch panel/limiter/amplifier rack is on the left. We're looking over the Neve console.



All of Manta's recorders are Studers. There are a total of eleven. Two are 16-track, two are 4-track, four are two-track, and three are mono. They are divided between the two control rooms. The 4-channel machine will be converted to 8.

The talent lounge is equipped with a pin-ball machine that can be played free. Dave Greene tells us that play is so active, that he is considering reducing studio rates and charging nickels for pin-ball play—but check the studio's rate card to be sure.

BOOKCASE

As a service to our readers we are pleased to offer these books from prominent technical publishers. All prices listed are the publishers' net. Shipping charges are included.
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by Dr. Howard M. Tremaine. New and updated, here is the complete audio reference library in a single volume. It provides the most comprehensive information on every aspect of the audio art. This new edition includes the latest audio developments including the most recent solid-state systems and integrated circuits. It covers all subjects in the fields of acoustics, recording, and reproduction with more than 3400 related topics. Each topic can be instantly located by a unique index and reference system. More than 1600 illustrations and schematics help make complicated topics masterpieces of clarity. 1760 pages; 6½ x 9-3/8· hardbound. **$29.95**
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EMPLOYMENT

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PEOPLE, PLACES, HAPPENINGS

• In a recently issued joint statement, **Peter Scheiber** of **Audiodata Company** and **Electro-Voice, Inc.,** a **Gulton** subsidiary, it was announced that U.S. Patent Number 3,632,866 has been issued to Scheiber covering encoding and decoding matrix techniques for four-channel recording and broadcasting. In a statement issued by E-V's senior v.p. **Howard Durbin** it was noted that the belief of the company is that the patent is basic and will cover all current or announced matrixing systems. He also indicated that it is the intention of E-V to issue licenses to assure the broadest possible base of manufacture for four-channel encoding and decoding hardware as separate or in-house circuitry.

• **Automated Processes,** located since its founding in Farmingdale, Long Island is expanding to new and larger quarters. A move has just been made to the nearby community of Melville. The new quarters will contain increases in all areas of the company's manufacture of console and accessory equipment. The new address is **Automated Processes, Inc., 80 Marcus Drive, Melville, N.Y. 11746**

• The appointment of **Philip Steyer** as product manager for all **University Sound products** was announced today by **V. Frank Jones,** general sales manager of University Sound. "This move is designed to increase the effectiveness of our University Sound management/sales/promotion team," said Jones, "because Phil Steyer will have deep involvement in each of these areas. He will be responsible for all new product development, and the corresponding correlation of its advertising materials; he will conduct product seminars across the country with our representatives and distributors; and he will assist our distributors and sound contractors with their local sales efforts."

• **Charles R. Buzzard** has been appointed sales engineer in the midwest region by **Philips Broadcast Equipment Corp.,** according to **James L. Wilson,** vice president of marketing. Mr. Buzzard's area encompasses the states of Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Iowa and Missouri. Prior to joining Philips Broadcast, Mr. Buzzard was sales engineer in the midwestern U.S. with **Central Dynamics Ltd.** of Montreal, Canada. Before that, he was chief engineer at **WLS-TV,** the **American Broadcasting Company** owned-and-operated station in Chicago, and previous to that was engineering supervisor on Chicago-based **ABC Wide World of Sports** operations in the United States and Europe.

• The **Austin Company** reports that its subsidiary, **Austin Sudamerica S.A.,** has completed construction of a building for **RCA's** new recording studios and annexes in Buenos Aires. The project consists of a main building which houses recording and control studios, central control room, re-recording and listening rooms, tape storage room, waiting room, administration and management offices. The project includes provisions for future construction of another recording studio. Acoustical design was performed by RCA engineer **Alan Stevens.** The acoustic treatment was carried out in three different stages, each one of them corresponding to a fixed area of the audio spectrum, thus obtaining a perfect relation with the bass, intermediate, and high frequencies. Different absorption and reflection panels, of concave and convex shapes which can move in different angles, were setup, thus obtaining an adequate syntony of the studio in different registers or types of music. An isolated and sound absorbent ceiling is suspended from the main ceiling.

• We would like to call our readers' attention to a newsletter published by the **National Center for Audio Experimentation.** It is full of interesting material for those involved in public radio and t.v. Although the group is primarily devoted to non-commercial broadcast interests, the work they are doing in such areas as binaural recording, stereo studies, etc.: will be of great interest to those in the recording field as well. You may receive further details by writing directly to **Mr. E. G. Burrows** at the **National Center for Audio Experimentation, Radio Hall, the University of Wisconsin, Madison, Wisconsin 53706.**

• **William J. Overhauser,** president of **Sparta Electronic Corporation,** recently appointed **Richard L. Jorgensen** to the position of vice president, finance. Formerly treasurer and controller of **Titanium West, Inc.,** Jorgensen is filling a newly created post with a broad base of responsibility. Jorgensen, a CPA and a graduate of the business school of the University of Minnesota, has previously held management positions in other major manufacturing and land development organizations.

• **Gately Electronics** has announced that arrangements have been completed with **Ortofon** to be exclusive American import agents for the Ortofon disk cutting systems. This new redesigned equipment features a 500-watt cutting amplifier assuring full level signals being cut at the frequency extremes. Systems are available for shipment from stock.

• The **42nd Convention** of the **Audio Engineering Society** will be held at the Los Angeles Hilton Hotel, Los Angeles, California, May 2-5, 1972. Technical sessions on new developments in the field of audio engineering will be offered, concurently with exhibits of professional audio equipment.

Here's what 8 FM station engineers said about the Bang & Olufsen SP-12 cartridge:

WVCG/WYOR Coral Gables, Fla.
...this excellent cartridge is ideally suited for professional applications. SP-12 would be a good choice for the new quad-4 channel-stereo discs.

KBUC San Antonio, Texas
The cartridge is without a doubt the "Rolls-Royce" of the broadcasting industry!

KRBE Houston, Texas
Low's and hi's came through very impressively over entire audio range. The SP-12 is an excellent cartridge surpassing both the Shure V-15 and the Stanton 681EE in all respects in my tests.

WKJF-FM Pittsburgh, Pa.
Tracking, so far, has been excellent. SP-12 has been used "on air" 7 hours a day since received and not stuck or skipped yet.

WEMP Milwaukee, Wis.
We appreciate the wide-range response without the harsh "edge" that so many cartridges add to the sound.

KDIG La Jolla, Calif.
An excellent cartridge, none better on the market today.

KBAY San Jose, Calif.
Up 'til now the Shure V-15 type II has been our favorite for critical listening. After installing the B & O cartridge in the shell the Shure cartridge was in, we've left it there. It sounds great!
Exceptionally clean, undistorted, pure sound. One London Phase Four recording in particular has always broken up during a highly modulated passage, we assumed the record was over-modulated, until we played it using the B & O cartridge.

KMND Mesa, Ariz.
If there could be any comment at all, it would have to be that the cartridge seemed to display a very smooth and pleasing sound, a very flat and very clean, clear and brilliant response. The separation is very good and both channels are quite consistent on response.

Write for a report of FM Station Engineer Evaluation

SP-12 Cartridge
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* Based on a study of all 600 U.S. recording studios listed in the 1971 Billboard International Directory of Recording Studios.

Model RE20 Recording Cardioid Dynamic Microphones photographed in the studios of Glenn Glenn Sound, Hollywood, California.

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