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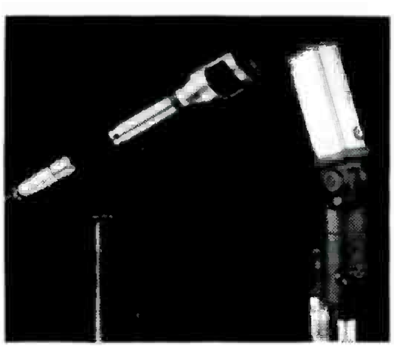
THE SOUND ENGINEERING MAGAZINE

FEBRUARY 1973 $1.00

The Wolfman... A howling success story.



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COMING NEXT MONTH

• We continue with our special reports on tape and tape products. Among the articles will be:

BIAS ADJUSTMENT WITH A HARMONIC ANALYZER. Many pros already know that a distortion analyzer can provide more accurate bias settings that peak (or past-peak) settings. Paul Berkowitz' article tells how it is done.

J. Ross Macdonald and C. A. Barlow, Jr. have submitted a paper that details better methods of azimuth adjustment, particularly with multi-track machines in mind.

A report on a new tape machine is given that describes a transport that has been designed from the ground up and built. It's an article that may set you thinking!

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

• You seldom see a headstack this closely. This one is from the Studer A-80 and is a 16-track stack in its plug-in assembly. In the direction of tape travel there are two erase heads (one for the even tracks, the other for the odd), the record sync stack, and the play stack. Between record and play, there is a scrape flutter idler. A full description of this remarkable machine is given beginning on page 22.

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THE SOUND ENGINEERING MAGAZINE

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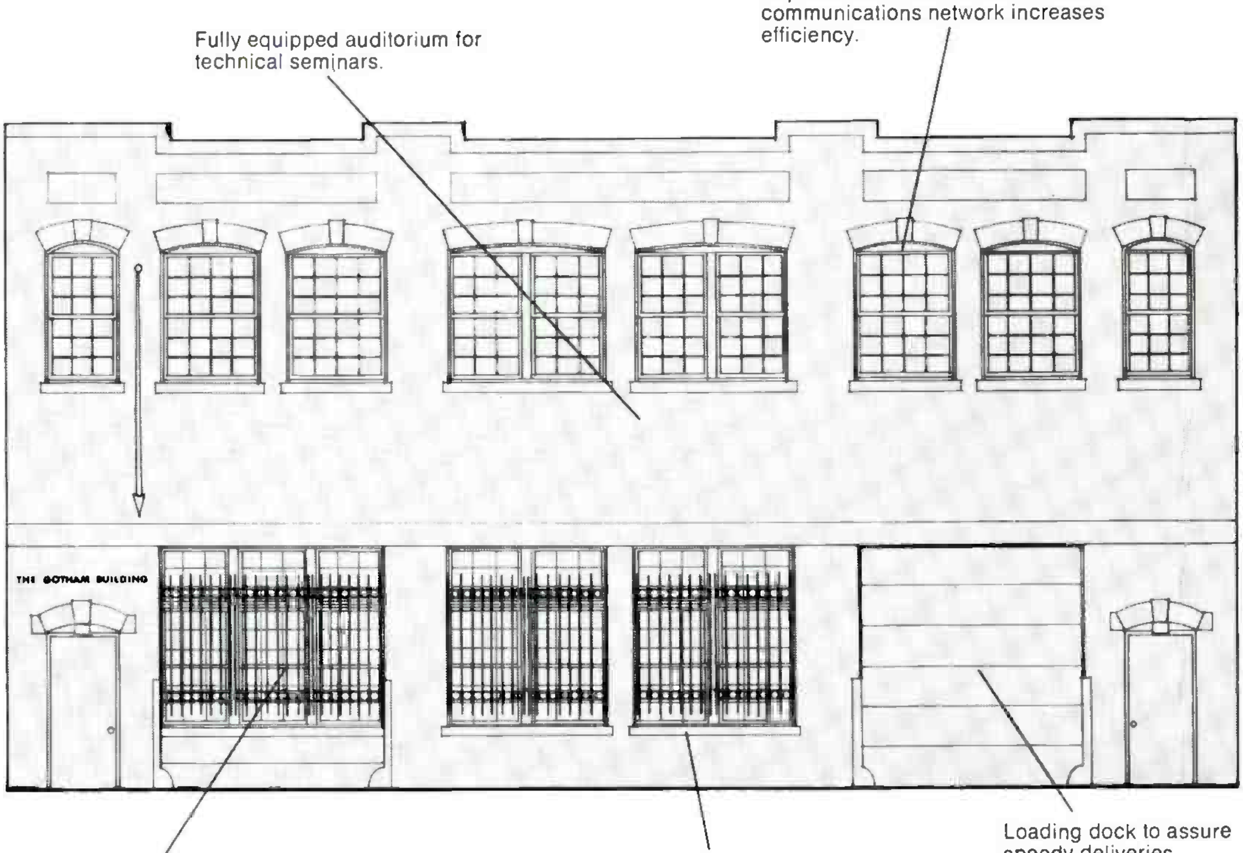

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George Alexandrovich

THE AUDIO ENGINEER'S HANDBOOK

Television and Stereo Sound

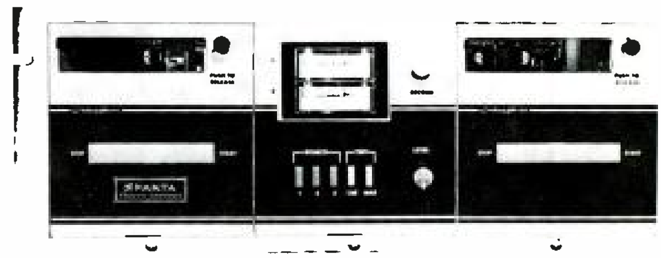
● On December 29th 1972 an experiment was conducted over two television stations in New York in simulating a stereo program. The program lasted half an hour and consisted of a mixture of several short scenes, optical illusions and camera tricks with participation of the comedians Bob and Ray. The program started at 11:30 P.M. when Bob Elliot appeared on channel 5 (WNEW) while Ray Goulding was answering him from channel 13 (WNET). In order to watch this program in full stereo you had to put two television sets a couple of feet apart and tune to two mentioned channels.

According to the bureau of statistics 68 per cent of the Americans in Metropolitan areas have two or more t.v. sets. Consequently, this program could have been viewed by many people—and as much as I can gather many callers during the show to the stations were expressing their praise for the experiment and specifically for the improved sound. Some callers were expressing their dissatisfaction with the contents of the program which contained a few moments not suggested for viewing by children. But since the program was shown so late at night there shouldn't have been any complaints.

The way the program was set up you had to have the set on the left tuned to channel 5 and one on the right to channel 13. The first trick Bob and Ray pulled was throwing a ball between the two channels. When I started watching the program at first I was carried away by the optical illusions and tricks two television cameras were playing over two discrete channels. But as the program continued I was no longer paying much attention to the picture but was amazed at the sound produced by the two small 9 inch portable sets. I have been conditioned over the years to the stereo sound reproduced by records, on an f.m. stereo tuner, or tape machine. Yet when I was confronted with stereo sound coming from television sets I felt as if I was in a theater; the television set no longer seemed to me as a source of background entertainment. The program shown was purely experimental and dull. However it provided an excellent means of evaluating the possibilities in television broadcasting not yet applied or fully explored. Partially this can be explained by a shortage of specialized programing, but just as few years back only a few stations could supply a limited amount of color programs, today a majority of shows, news programs, cartoons, and even commercials are in beautiful bright colors. So too, can audio be improved and transmitted in stereo. Technically speaking, the know how and equipment to do this job is available to us. The only thing remaining is to persuade receiver manufacturers to treat audio not as a stepchild of picture, but as an older brother. Many times in the past I have commented to this effect—that you can have audio without video but it is impossible to sustain a show or program without sound. Even some special movies where there is no human voice heard, sound effects play a most important role in creating mood and adding meaning to the picture.

Now, back to the sound. We all know that f.m. stereo became quite popular, not only because it was a novel way to listen to the radio, but because of esthetic pleasure a listener derives from perceiving sound from two dimensional source. So, for now let us just hope for stereo multiplexed sound on our t.v. channels.

Some ten years ago I installed a sound system into Bankers Trust conference room between their Park Ave-



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nue offices and Wall Street, New York. The system was a two-channel closed-circuit system with equalized audio lines up to 10 kHz. A gain-shifting principle was used for hands-free operation. Broadcast type equipment was used throughout including the shotgun microphone E-V 642. Closed circuit t.v. with 27 inch screens was part of the system. High resolution cameras with an overhead document camera were used in order to achieve best possible picture. It was most pleasing to hear voice from the person you saw on the right hand side of the screen coming from the right speaker, from the person on the left from the left speaker, and a person sitting in the center from the center. We have experimented by switching channels and you wouldn't believe how much confusion sound coming from the wrong channel can cause. We would instinctively look for the person on the right side of the screen while he was on the left. Many times t.v. would break down but the conferences were still being held. When audio would malfunction we would be summoned in a hurry to correct it because their communication link was broken (in ten years it only happened—to my recollection—twice).

This sensitivity of the human ear and eye working in synchronism brings up several interesting points we should be aware of in trying to apply stereo sound to the t.v. picture. Unless we take some pain to have sound follow video and present it in proper relationship to the field of view, a stereo effect will only add to the confusion, especially during fast moving episodes with plenty of action. What could be more realistic and exciting than hearing the crowd during a football game. Then, when the picture is switched to the field camera with closeups of players knee deep in slushy mud, hear the sound of splashing puddles, cracking of helmets, loud puffing of running heroes—all in living stereo!

Let us for a moment talk about the techniques of shooting a picture with t.v. camera and sound, so that viewing becomes more realistic. For instance, many times the cameraman takes closeup shots of someone talking. I think that the zoom lens eventually could be feeding information into a sound control computer which would automatically bring up this person's voice and reduce gain of other mic channels. Rotation of the camera or panning should be tied with panning sound—creating a true stereo-space image.

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Dictaphone and Ansafone are registered trademarks of Dictaphone Corp., Rye, New York and much more so getting a good sound at the same time. This is why sound movie cameras for home never became as popular as manufacturers had hoped. Certainly, taping a show and achieving good stereo sound at the same time is just as hard as producing a stereo album. Not only more equipment is needed (and knowledge as to how to set it up in a studio) but also a good mixer to mix it all down with proper balance and most important—in unison with the camera. This is why good motion pictures are so costly and there are so few.

There are many reasons nevertheless why we should drive for stereo in our t.v. programs. I have built several consoles for major t.v. networks and many other stations—and have to admit that it saddens me much when I listen to the tiny speaker to think of those 42 inputs with five subchannels and two output channels with performance standards matching those of recording systems and those beautiful sinewaves getting lost somewhere between the demodulator and the 50-cent output transformer of the receiver. With present day technology it would not take more than couple of dollars (manufacturers' cost) to beef up the audio and little more to include stereo matrixing. I can see much sense for the cable t.v. enterprises to use stereo sound to make t.v. viewing over cable more attractive. Once somebody starts providing stereo sound new, adaptors and attachments would become available and be in demand. Not only may it become a good market for electronics manufacturers and their distributors but also for the consumer who will derive pleasure from improved sound—just as the four-channel concept is beginning to make headway in consumer audio (professional audio as we all know is already past 16 channels).

In view of the fact that in the past quarter of a century no change in audio circuits of the receiver have been made while video has gone through the development of color—and now experimentation has made the three-dimensional picture realistic, as well as large screen viewing, solid-state picture panels and application of holography to the flat screens, we should expect some improvement in sound.

Again I think that director Ted Barzyk and the staff of WGBH Boston have done a good job in preparing the program seen in New York proved to me that stereo sound and picture belong together. At first we should not expect miracles. A few years later, listening to mono t.v. may be just as strange as going to the movies and watching a black-and-white picture. ■

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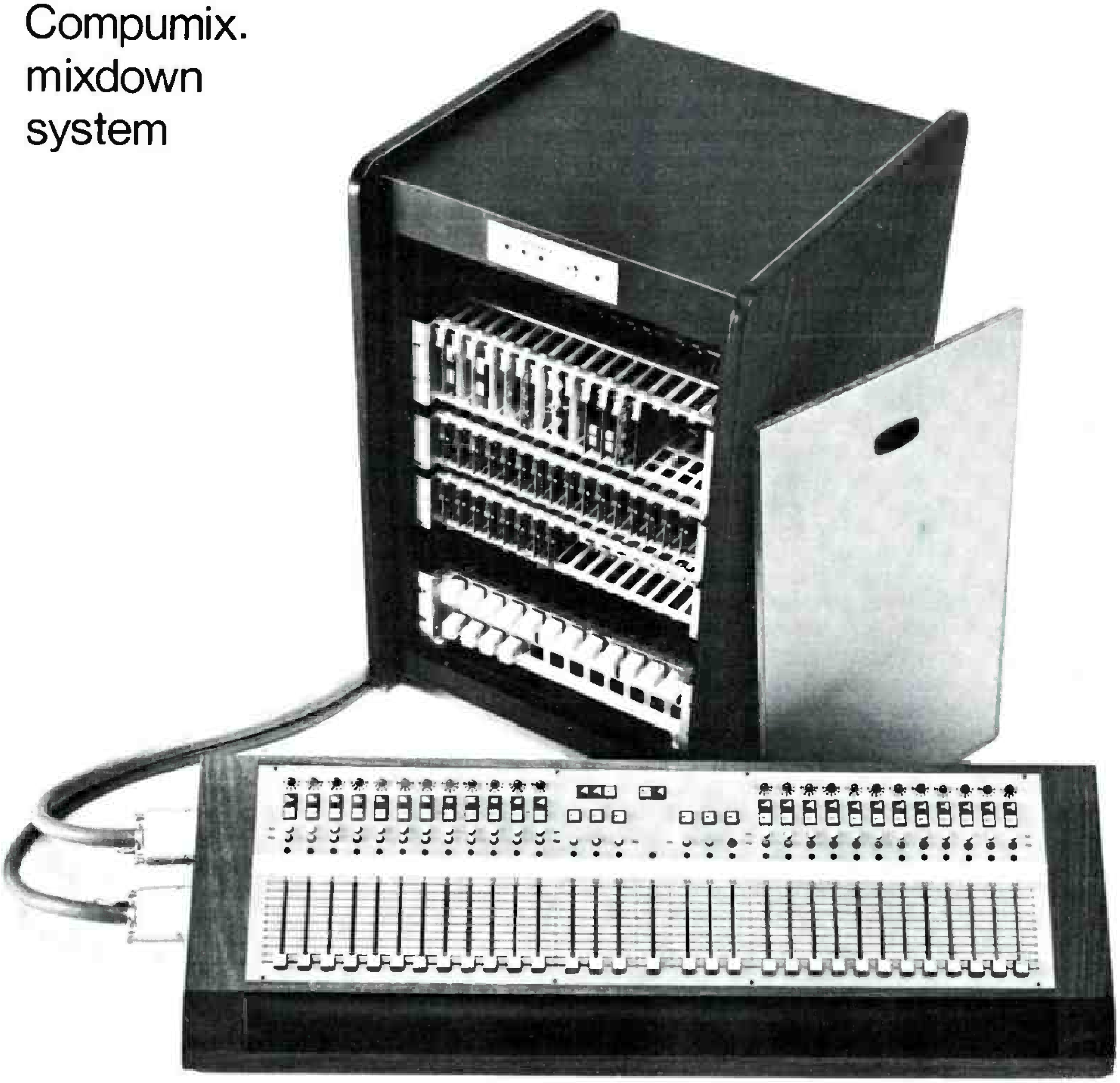

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John M. Woram

THE SYNC TRACK

Getting Back to Basics

● About twice a year, I come down with a mild case of depression—brought on by my inability to keep on with the letters that the editor, in his malevolent wisdom, forwards to me for answering. Since I make my living as a recording engineer it seems I am a natural for answering all the "how do I get started?" inquiries. I suspect that the other columnists—a very suspicious bunch indeed—also slip me their letters on the subject.

When the letters pile up too high, I usually devote a column to some aspect of getting started in recording, hoping that I can in this way respond to the greatest number of inquiries in a reasonably efficient manner. At times, I wonder if this is such a good idea, since each column of this type seems to inspire even more "getting started" letters. Either the writers aren't reading, or there is more interest in this subject than one might expect.

Well, I wonder what more can be said, without getting repetitious? There are no formulas for getting started, and the multi-page guidance counselling requests cannot in all fairness—be properly answered by mail. Beyond a little philosophizing, I can't say much about the advantages of going to this or that school, or, whether you should study one particular subject instead of another.

As a fr'instance, I'm still doing a little teaching at the Institute of Audio Research, one of several schools that offer courses of interest to beginners in the recording industry. Apparently, the school is doing *something* right, since each term the classes get larger. But, does it guarantee jobs to graduates? Definitely not. All the diplomas in the world will not create a job opening. However, when an opening does come along, if you can demonstrate that you had the interest and tenacity to take a course in recording, you may be in a better bargaining position than the fellow with nothing more than a claim to be interested in the industry.

A diploma may say more about you than about the institute that granted it. But, it doesn't *guarantee* a thing. It lets your employer know that you seem to be serious about working in the recording business. But, it doesn't tell him whether you actually learned anything.

By now, I've talked to enough classes to realize that each one may be sub-divided into perhaps three sections, one of which will immediately fall asleep. Section 2 will sit there listening and dutifully taking notes on everything that is said, but will contribute little or nothing. Section 3 gets the jobs (*when* they're available). They're the ones who ask the questions and who make sure they get the most out of what's being offered.

In other words, the same exposure to education will have varying effects, depending on the individual. You can get a lot out of going to school, or nothing at all. It's up to you.

I hope this answers the recurring question, "Am I wasting my time and money studying something I really don't need?" Beyond these comments, that's really an unanswerable question.

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Witness for the Living Sea. Jacques-Yves Cousteau outlines 4 points that could keep the sea and mankind alive.

Vanishing Point. A regular feature. So far, we've considered the alligator, coyote, tule elk, sea otter, dolphin, brown pelican, wild mustang.

The New Panama Canal. What will it do to the waters, the islands, the people? Whom should you write – and why?

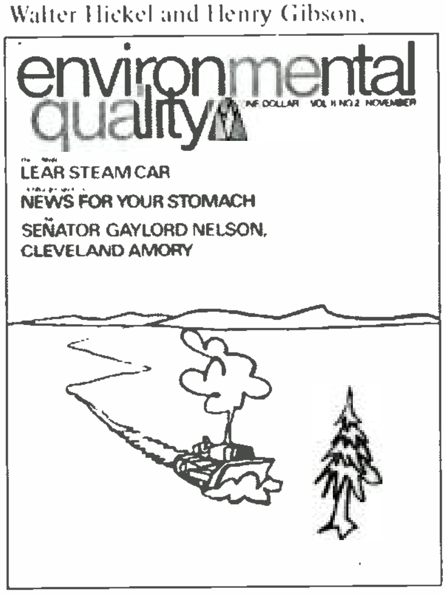
Keep Out of the Reach of Children. Cereals are healthy for TV, no so healthy for kids. A hard look at American way of breakfast, with cost and nutrient analyses of 33 breakfast foods. Other articles have examined baby foods, hamburger, water fluoridation.

Strip Mining: The Prostitution of America. And the disgrace. Richard Cramer suggests other choices.

Obscenity and Ecology. Joseph Sorrentino wonders why cops and courts go after porno peddlers with such zeal, while letting polluters sock it to society with such impunity.

Engines and Alternatives. In separate articles, we've examined the Wankel rotary engine, the Lear steam machine, the bicycle and the turbine motorcycle.

Interviews. We've talked with Walter Hickel and Henry Gibson,



Senator Gaylord Nelson and Cleveland Amory. We've followed William Ruckelshaus through 2 days, and published Ralph Nader's views on 23 issues.

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Certainly, you don't *have* to have a passing grade in Communications III (whatever *that* is) to get into a studio. You may not even need a high-school diploma. But, if you flunked out of high school, you're probably going to have trouble later on, and, if you're wondering about continuing in Communications III, why on earth are you there in the first place?

No matter what course of study you pursue, you will have to take at least a few seemingly irrelevant subjects. For example English composition, or speech. If you think this is time wasted, just wait till you're in one of those studio situations where your success depends entirely on your ability to express yourself. All these engineering courses you took won't be much help if you can't string a few words together.

Talking about stringing a few words together, this little epic seems to be getting out of hand. The point is. there is obviously a great reader interest in getting started in the recording industry. Therefore, the above mentioned all-knowing editor has suggested that I might devote some of these columns to discussing the "basics" of recording. As I recall, he pointed out that since I have been "getting started" myself now for some 15 years, I should be in a good position to talk about it. We'll see.

And that brings us to another point. Assuming there is an interest in some of the basics, how about some letters with specific questions, or suggestions, about what should be covered?

With all this getting-started talk, it might be well to speculate on a definition of good engineering. That's not as easy as it may seem. For example, NARAS annually awards a Grammy for the best engineered record of the year. Record company members suggest recordings that they feel are worthy of consideration for an engineering award. Some 200 records are pre-screened by an engineering award committee, and eventually a list of 5 records are presented to the membership for a vote.

Although 200 records may seem like a lot of listening, it really doesn't take too long to find the finalists. Try this simple listening test. Take a large group of records and quickly spot check each one. At first, spend no more than a few seconds on each record. Chances are, most of them will sound pretty much the same, particularly if you try to tune out the artist, the arrangement, and the song itself and concentrate *only* on the quality of the engineering. Occasionally, a record will arrest your attention due to the magnificence of the recorded sound. Once you've found a few records that are really superb, spend a little more time comparing them with those records that weren't very impressive during your first listening test. You'll notice that the differences are amazing.

Meanwhile, back at the NARAS engineering committee, the differences were likewise startling. However, remember that the 200 records being auditioned were all sent in by industry pros who—one might expect—would know a good engineered product when they heard it. Yet, at least one outfit sent in more than 20 records, ranging in quality from excellent to wretched. Interestingly, UNI Records sent in just two records, *both* of which made it to the finalists list.

Confusing, isn't it? Apparently, good engineering is obvious to some, but not to others. And, if confusion exists within the industry, how can the beginner be sure that his own best engineered choices are really the right ones?

It might be worth it to carefully review the five records nominated for best engineered recording and compare them with other recordings in your collection. Here they are:

Title	artist	engineer
Baby I'm-a Want You	Bread	Armin Steiner
Fragile	Yes	Eddy Offord
Honky Chateau	Elton John	Ken Scott
Moods	Neil Diamond	Armin Steiner
Son of Schmilsson	Nilsson	Robin Cable, Ken Scott & Phillip MacDonald

For that matter, if you have any other records around that were engineered by any of the people listed above, you'll find them to be uniformly excellent.

Now, all we have to do is figure out *why* these records are so noteworthy. What mysterious secrets do these engineers have that are unknown to the rest of us? Wouldn't it be great to know what mic Ken Scott used on Elton John's piano? And, do you suppose Armin Steiner uses a particular limiter on Neil? I don't have the answer to either question, but even if I had, it really wouldn't do anyone else much good. The great engineering you hear is the sum of *all* the parts; microphone, placement, musical instrument, artist, studio, and so on, right through to final mixdown. Any one of or all of these elements might not work in another context. ■

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● Two new mic stands, model ST212 and ST199 have been added to the existing line. ST212 is a giant stand using a heavy duty tripod with a telescopic stand that extends to a maximum height of 7½ feet and has a boom that reaches over 6 feet, so it can position a mic up to 13½ feet above a studio floor. The boom is counterweighted and can be adjusted through 360 degress. At the other extreme, the ST199 is a lightweight that telescopes down from a height of 4 feet, 8 inches to a compact 17 inches and weighs approximately 2 lbs. when fully extended, 95 per cent of the weight is at the base.
Mfr: Beyer (ReVox)
Price: $84 (ST212); $13.50 (ST199)
Circle 51 on Reader Service Card.

Circle 29 on Reader Service Card

TIMEKEEPER TAPE TIMERS

The well-known TIMEKEEPER TAPE TIMERS are now available for immediate delivery. Our latest shipment has arrived and we are ready to fill your order.

TIMEKEEPER TAPE TIMERS are easily mounted on any ¼-inch recorder. They are fully guaranteed to meet with your complete satisfaction or your money will be promptly refunded. At these low prices you can no longer afford to be without a tape timer.

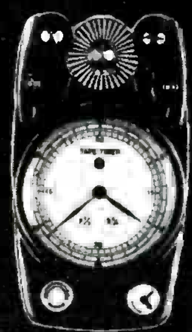
Difference from the Stop-Watch

Since the stop-watch measures time independently of the travel of the tape, its measurement inevitably varies with the elongation or contraction of the tape and with the rotating speed of the tape recorder, subject to change by voltage and other factors. The stop-watch can be stopped during the travel of the tape, but it cannot rewind together with the tape back to the desired position. With the Tape Timer moving in unity with the tape recorder, fast forwarding of the tape involves the quick advance of the pointer, while rewinding of the tape moves the pointer backward by the corresponding time.

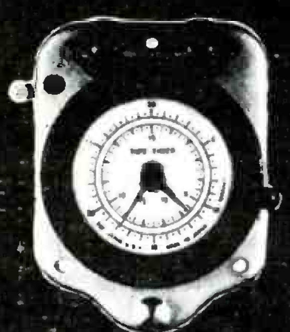
Correct time keeping of the Tape Timer is never deranged by continuous repetition of such actions during the travel of the tape, as stop, rewinding and fast forwarding. Unlike the stop-watch, the Tape Timer is not affected by various factors of the tape recorder, and so the editing, reproduction and revision of your recorded tape can be done at will.

Features

- The recorded portion of the magnetic tape can be read at a glance by a scale division of ¼ second as accurately as a clock.
- The performance of the Tape Timer synchronized with the tape prevents such errors as caused by the elongation or contraction of the tape, and by the variation of speed in the rotation of the machine. Fast forwarding of the tape involves the proportional increase of the advance on the Tape Timer. When you rewind the tape, the pointer will be automatically moved back by the space of time exactly corresponding to the rewound length. You are free to stop, rewind, fast forward, or forward the tape even continuously and repeatedly without deranging the timing on the machine, thus prohibiting errors. These excellent characteristics will enable you to simplify the most complex procedure of editing, revising and otherwise processing your tape recording.
- Every fast rotating part is provided with a precise ball bearing, so that the Tape Timer can be employed at high speed with no need of lubrication.
- This trouble-free, high precision Tape Timer, within an error of 2/1000, can be simply fitted to any recording or editing machine.



The Standard Model is calibrated for 7.5 and 3.75 ips and can also be used at 15 ips. Dimensions are 1⅞" x 3¼". It is priced at only $49.95.



The Professional High Speed Model is calibrated for 7.5 and 15 ips. It measures 2½" x 3¼" and is priced at $99.95.

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Total for Tape Timers $ ______

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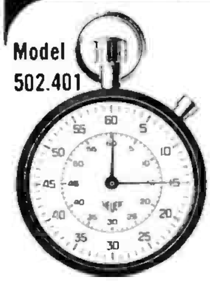
stop watches

These are Switzerland's finest quality stopwatches manufactured by Heuer-Leonidas S.A. Heuer has been the leading manufacturer of quality stopwatches for over 100 years. Their reliability and design leadership are well known throughout the world.

All are fully guaranteed for one year with service available in 90 countries. Isn't it time you had one of these new models?

If you are seeking a stopwatch for a special application please let us know. Heuer stopwatches are available for sports, aircraft, automotive, industrial, scientific and many other uses.

Model 502.401

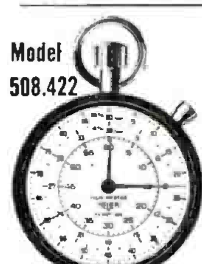


1/5 second recorder, central 0—60 minute register. 2 crown functions with time-out and locked return. 7 jewels, shock-protected. $58.00

Model 501.201

1/5 second recorder, central 0—60 minute register. 1 crown function with side-slide. 7 jewels, shock-protected. $50.00

Model 508.422



FILM-MASTER. 60 second recorder, central 0—60 minute register. Records on outside scale consumed 35 mm film from 1—90 feet, on intermediate scale consumed 16 mm film from 1—36 feet. Framespeed 24 pictures/second. 2 crown functions with time-out and fly-back return. 7 jewels, shockprotected. $61.00

Model 502.050

WRIST TIMER for program directors in radio, TV and film. 1/5 second recorder, central 0—60 minute register. Dial reading indicates elapsed time; remaining time can be read on 60 minute turning bezel. 2 crown functions with time-out and locked return button with safety bolt. 7 jewels, shockprotected: $74.00

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Circle 22 on Reader Service Card

The MD 441. So good it almost worried us.

If we didn't have such good condenser microphones, we'd be worried. Because when it comes to performance, the MD 441 doesn't leave much to be desired. Especially when you consider it's *not* a condenser microphone.

The response curve may leave you uncertain, however. Smooth and wide, extending from 40 to 20,000 Hz. And a super-cardiod directional pattern whose traces at various frequencies look like an Olympic skater doing "school figures".

The MD 441. Beauty more than skin-deep. Our design goal was ambitious: a microphone to satisfy performers and engineers alike. With remarkably critical reproduction . . . yet remarkably *non-critical* in use.

One major problem: mechanical noise. While super-cardiod directionality is extremely desirable, previous dynamics of this type could not be hand-held because of mechanical noise and vibration conducted through the housing. However, in the MD 441, the problem is solved with a *double* housing. The microphone element, in an inner housing isolated by means of a compliant suspension, is shielded from mechanically conducted noise. Bringing studio 'quiet' into the performer's hand.

Depth. Presence. And absence. To make the MD 441 even more practical and flexible, we added three more features. The first two are presence and bass switches, which offer a 5 dB boost at 5 kHz and five-position attenuation, repsectively, to selectively enhance vocals and instrumentals, while preventing overemphasis of low frequencies. And, to provide optimum close-miking, the MD 441 features an absence of pops and proximity effect, due to its novel pressure-gradient design and integral windscreen.

We could tell you more about the remarkable new MD 441 dynamic microphone. But if it's good enough to almost worry *us*, using it will likely delight *you*.

SENNHEISER
ELECTRONIC CORPORATION
10 West 37th Street, New York, N.Y. 10018
Manufacturing Plant: Bissendorf, Hannover, West Germany

NORMAN H. CROWHURST

Tape Technology Today

Tape technology did not spring forth from a void to the present state of the art. The author takes us from the beginning and describes how we got where we are.

Magnetic tape—you've come a long way baby!

OVER THE PAST FEW DECADES, recording technology, using magnetic tape as a medium, has advanced at an unbelievable rate. Maybe the researchers, who have developed the basic new raw materials, have been impatient, feeling that industry is slow to catch up with the advances for which they have been primarily responsible. But that has not been the view of tape and machine manufacturers, professionals who use tape every day, and audiophiles and others who constitute the end recipients of recorded program.

To those who have been with it longest, the advancement is nothing short of phenomenal. It is difficult to realize that, at one time, there was even an argument between tape and wire protagonists, the wire people contending that their medium was more permanent! Anyone who ever tried to unsnarl a spool of wire that had gotten out of hand may wonder at that. The only thing to do was to throw it away and start over.

But tape has come a tremendously long way since then. In those early days, there was some discussion whether 30 inches per second gave adequate quality, nobody would have thought of suggesting narrower than quarter inch tape—for only *one* track, and tape thickness could not be reduced to less than 3 mil (0.003 inches) and remain stable. Using this material, a 7 inch spool would comfortably hold about 600 feet of tape, which would play for about the same time as an old 78 disc—4 minutes!

Now, if you people who "just came in" think all that was needed was to run the tape slower, make the tape thinner, and make narrower tracks, you're quite wrong. In those days, to attempt to make any of those changes would have been fraught with trouble. Running the tape slower would have destroyed the frequency range, making the tape thinner would have resulted in impossible print-through, and using narrower tracks would have kissed any dynamic range at all good bye!

Yet the fact is, today we are using tape that squeezes as many as 8 tracks into a quarter-inch width of tape, runs the tape at 1⅞ in/sec. and uses tape that is only 0.0005 inches thick. That combined improvement means the same length of tape would carry 8 times as much track, the track would take 16 times as long for each foot played, and the spool would carry 6 times the length.

So the same spool full of new tape would play 768 times as long as the old tape, with essentially no loss in quality, in any of the respects that seemed inevitable from experiments with the earlier tapes. Instead of 4 minutes playing time, we can now get over 50 hours of single channel, onto the same sized spool! Magnetic tape—you've come a long way baby!

Of course, nobody wants 50 hours on such a spool. Instead, we use what then would have seemed a ridiculously small cassette, and we play multi-track to get stereo, moving into quadriphonic, or whatever you want to call it, and still get much longer playing time than was ever dreamed about in those days. In technology, that's known as distributing the benefits.

To the end user, all that seems so simple. But to the people who design, make and package the merchandise, it has meant countless hours of problem solving. Each step—and that advance was not made in one easy step—produces its own problems to be solved: higher precision, closer quality control, etc., as well as resolving the diversity of transitions to be made.

IMPROVEMENTS IN MATERIALS

The earliest oxides applied to plastic tapes were essentially "soft" magnetically: their coercivity being low, they retained little of the magnetization impressed on them. Because of this, they were particularly apt to lose the ex-

. . . with the advent of a new material, only a few brave souls will be prepared . . . to give it a try.

Norman Crowhurst should be familiar to readers of db as the monthly columnist of Theory and Practice.

In technology that's known as distributing the benefits.

tremely short "magnets" associated with the higher frequencies recorded. Also because of this, they were susceptible to print through between adjacent layers of tape on a spool: easy go, easy come!

So increasing coercivity automatically improved those things that depended on it—or made possible those improvements: higher levels could be retained on the tape, thus increasing dynamic range, other things being equal, and making possible narrower tracks; self-demagnetization was reduced, extending high frequency capability and enabling 'slower tape speeds to be used; and print-through tendency is reduced, enabling thinner tape bases to be used.

But the improvements we spoke about earlier are a fantastic change to attribute to making better oxides. In fact, the change in magnetic material goes much further than the increase in coercivity shown on its magnetization cycle indicates. The early magnetic materials consisted of oxide crystals randomly suspended in the bonding agent that secured them to the film base.

Early improvements consisted of achieving a denser concentration of oxide crystals in the bonding agent, and then of orienting them so their direction of easy magnetization runs lengthwise to the tape, rather than randomly. This, combined wtih attention to processing that can increase coercivity, considerably improved the achievement of the oxide materials.

All the coating materials to this point were characterized by possessing a brownish coloration. Their crystaline structure is called spinel, or inverse spinel, from analogy with the crystal structures associated with precious stones, as revealed under microscopic examination. Work with oxides turned up a different material, chromium dioxide, that has several differences from the older iron oxide.

Its crystals have a rutile, or needlelike shaping, rather than the variety of cubic shapings characteristic of iron and nickel crystals. If you'll pardon a comment from my British background, this leaves the baseball diamond in favor of a cricket pitch! We have a whole new ball game.

Another change in material was needed, when it became possible to use a thinner base film without serious print-through problems, which was first possible with high-coercivity ferrous oxide and even better with chromium dioxide. Most plastic films have tolerable dimensional stability under mechanical tensions, when the thickness is 3 mil or greater. But reducing thickness to 1 mil and less —even half mil—can create problems. A good material must be able to bend, as in going through the transport mechanism, but must not stretch under normal tension. Mylar or tempered polyester have the superior stability needed for this.

With the much tinier magnetization patterns laid on the tape, as represented in the lower speeds and narrower tracks, along with the higher magnetization acceptable by the material, the construction of heads to work at such high intensity and concentration became a problem. Earlier heads had used gaps of about 1 mil (0.001 inch) for playback and wider for record and erase.

These are much too coarse for the new tape materials, running at the lower speeds rendered possible. At first sight, it might appear that making the gaps finer is principally a process problem—one of getting the gap that fine and precise.

. . . increasing coercivity automatically improved those things that depended on it . . .

Earlier heads were made of low hysteresis nickel-iron alloys, such as mumetal. For the relatively low density magnetization which was the limit for earlier oxides, these served the purpose admirably. But as newer oxides were developed, capable of higher level, and possessing higher coercivity, higher magnetizing forces are needed, exerted in the extremely tiny areas just described.

This led to the development of ferrite heads, which have several advantages. As well as enabling tinier gaps to be made and adequate magnetic intensity to be concentrated on the tape, they wear much better than their metallic predecessors.

PROCESSING IMPROVEMENTS

Having better materials to work with is one thing. Employing processing techniques that take advantage of the possibilities made available thereby is something else. Ever since the beginning of tape as a medium, one problem has been that of drop-outs, and other effects due to non-uniformity of the tape coating.

This can take two forms: either the quality of the coating can vary, so that level drops, or distortion occurs because there is virtually a hole in the magnetic properties of the coating (which may not show as a physical hole); or the coating may have a deformation that causes a spot along its surface to leave perfect contact with the head, thus having the same effect, although the coating itself may retain its full magnetic properties.

The latter effect may, to some extent, be overcome by using greater tape tension to keep the tape in close contact with the head. But increasing tape tension can introduce other problems. Unless the tape has a correspondingly higher stability—which also necessitates higher tension to overcome the same tendency to leave the gap—increasing

Another change in materials was needed, when it became possible to use a thinner base film . . .

tension may momentarily stretch the tape, causing a whole variety of undesirable effects that we will not go into here.

Use of improper tension may also cause the tape to squeak, either in passing over the head, or over some of the guide posts. This squeak is due to the fact that the tape moves in a high-frequency succession of jerks, rather than a smooth movement. The squeak itself is acoustic and does not directly appear on the recording as a squeak. But the erratic movement that causes the squeak will also cause distortion of the signal impressed on the tape.

On the earlier tapes, using a magnetic gap that extended the full quarter inch width of the tape, and traveling at the faster rates used all the time, the various drop-out effects were less important. A drop out was unlikely to extend the whole width of the tape, and it went by rather rapidly. It destroyed the perfection of the recording, admittedly, but far less noticeably than the same area of imperfection would affect the more minute, slowly moving tracks in use today.

So precision in quality—fineness and thickness—of coating is far more important today than it was earlier. Where it was sufficient to run checks on the "tails" of tape rolls in earlier times, it has now become necessary, to insure good quality throughout, to monitor the entire roll for uniformity of coating thickness and surface smoothness.

Surface smoothness is a function of three things: the quality of the coating mix applied—molecular structure of the magnetic material and its suspension in the bonding agent; the evenness with which it is applied; and subsequent polishing operations, to improve the surface. Attention to each aspect must do its part toward a satisfactory product.

Use of improper tension may cause the tape to squeak . . .

The switch from iron oxide to chromium dioxide is in itself a help. The finer molecular structure, coupled with procedures to orient the molecules longitudinally on the tape, results in a surface that is naturally smoother than iron oxide ever was.

We spoke just now of coating a roll of tape. You may have noticed our use of the word *roll* instead of *reel*. Can you imagine the problem of coating miles of tape only a quarter of an inch wide—or worse yet, only 0.150-inches wide, as used in cassettes? Getting a uniform coating, both width-wise and length-wise would be some problem. It is easier to obtain uniformity over a larger surface, such as roll of tape from which a considerable number of quarter-inch or narrower tapes will later be cut.

With 3-mil tape, slicing was not too much of a problem. But with reduction of thickness to 1-mil and thinner, it became a problem. Try working on regular drawing paper, and then on onion skin, with a razor blade, and you'll see what we mean. Slicing plastic tape bases poses the same kind of problems.

First there is the problem of ensuring that the slice runs exactly parallel to the direction of the roll at all times. so the resulting tape has parallel edges and uniform width throughout its length, to extremely fine tolerances. That is not all. With modern multi-track tapes, the whole width of the tape must be usable, providing the same perfect recording quality.

Slicing has a tendency to "jag" the coating on the tape,

A good material must be able to bend . . . but must not stretch . . .

leaving little bits hanging that will fall off later, and so forth. Such particles must be extremely small—approaching the molecular size of the magnetic material in the coating—and they must be properly cared for, so they do not get transferred to where they can spoil a recording. Slicing has become a whole technology in itself!

We could undoubtedly go into some of the smaller details that most companies are not anxious to release, as being trade secrets about their processes—if we could get all that information from them—but we have said enough to indicate the nature of the materials developments that have occurred and the production problems that tape manufacturers have to cope with. But that is not quite all the manufacturer has to consider.

What good is it, if a manufacturer develops a vastly superior variety of tape, puts in all the expensive equipment needed to make it, and then, when the user buys it and tries it out, it does not seem any better than the material he has been using, because his equipment is not capable of utilizing the improved capability of the tape? So he must pay attention to transitional problems.

PROBLEMS OF TRANSITION

From the foregoing, you will see that improvements should involve the complete system, to achieve maximum effect. If someone buys a reel of new tape, threads it through an old machine and uses it, he may find some improvement but probably not enough to make it seem worth the extra cost to him. To get the full improvement of which the new tape is capable, he may need new heads and he will almost certainly need to adjust the level of high frequency bias he uses.

In the reverse direction, if someone buys—perhaps because it is cheaper—some of the older varieties of tape, with the intention of using it in a machine designed and set up for using the newer tapes, theresults will be hopelessly poor, because the tape really is inferior, and additionally the machine is not set to make the best of it.

From the viewpoint of recouping the cost of going into production with a new product, that takes as much tooling up, laying out of space and so forth, as improved tapes inevitably do, it would be very nice if tape manufacturers could persuade a sizable segment of their market to junk their old systems and invest in new, to take their tapes. Then it might be feasible to produce the new materials at a cost commensurate with the older ones.

Any manufacturer that expects that to happen is asking to go broke! In a country as saturated with advertising as ours is, people believe less than half of what they read. So with the advent of a new material, only a few brave souls will be prepared, initially, to give the new stuff a try. If it proves itself satisfactorily superior, they will schedule a progressive swing over, trading old equipment for new, as needed, to update their facility with minimum interruption.

So the manufacturer must be prepared for the fact that the initial market will be only those who are really determined to have the best, for whom economics comes secondary. Maybe that is not quite true. Perhaps it would be better to say that these clients see their reputation for having only the best as being part of *their* economic picture, thus setting them apart from the mass markets.

So the transition problem has two parts: one technical, one economic. The technical part is concerned with how the transition can be made, to optimize new developments at minimum cost for the user. Now that we can supply him with better tape, what changes in his equipment should be made, so that he can justify a switch on the basis of the improvement he realizes?

As you see, technical consideration of the changes involved is only part of the picture. The other part is economic, partly for the supplier, partly for the user.

Until the supply of a new product picks up momentum, it may be doubtful whether production will be self-supporting, much less being able to pay off the development costs that resulted in the new product. That must be set for a longer term, when sales begin to pick up. So in this sense, getting a market started for a new product must be added to the development costs, in formulating the long-range plans.

Over the long run, the improvements bring cost down. Look how much less tape is needed today, to accommodate a few hours' recorded program. The tape itself, on a footage-times-width basis, could cost several times as much as the older varieties, and still enable program to be made available for less, as measured in cost-per-hour of recorded program.

And compactness has a value, especially for some applications, such as use by a roving reporter. As we said at the beginning, tape has come a long way. How much further it will go, only the future will tell, for sure. ■

Slicing has a tendency to "jag" the coating on the tape . . .

Digital Control for Sixteen Channels of Tape

The Studer A-80 multi-track machines use innovative techniques for tape motion and operation. This detailed report examines them.

In the Spring of 1970, Willi Studer surprised the professional field with his new A-80 master recorder designed to handle tape widths up to 2 inches. The first machine was completed in July 1970 and production began that November. Up to the end of January 1971, more than 30 multi-channel machines were delivered. This report offers several illustrations of this highly sophisticated design for a 2-inch deck.

When one hears from Regensdorf of a "milestone in the history of magnetic recording" this principally refers to the use of modern servo control and solid-state technologies. Among the most important new developments used in the A-80 is the electronic control of both the capstan motor and spooling motors, the electronic tape tension control, digital motion logic, and remote control of all functions. Electronic control also extends to tape motion sensing, amplifier equalization and speed switching. The tape timer is a real-time counter for either tape speed. All push-button lamps are actually function reporting lamps which is also true for all the remote control button systems which are external to the machine.

All mechanical deck elements are mounted on a warp proof cast aluminum chassis and are readily accessible for replacement (Figure 2). The deck rotates in the console about a horizontal axis permitting access to the motion logic electronics even during operation. The electronics are mounted on eight easily exchanged printed-circuit cards: input attenuator, i.c. memory, i.c. decoder and driver, spooling motor control, spooling motor relays, capstan motor control, oscillation and voltage stabilizer. The oscillator supplies an erase frequency of 80 kHz and bias of 240 kHz.

In place of a conventional relay system, the A-80 contains a motion logic system using integrated-circuit elements. This provides a completely contactless control system right down to the lamps under the control push buttons. The motion logic consists of three cards of which the input attenuator serves as the signal processor for the following i.c. memory card. In the decoder the memory output signals are decoded and fed to the driving elements. These directly control the electro mechanical elements of the tape deck.

This article appeared originally in modified form in Radio Mentor in Germany. It has been translated from the German by Stephen Temmer of Gotham Audio Corp.

Figure 1. The complete A-80 Studer machine.

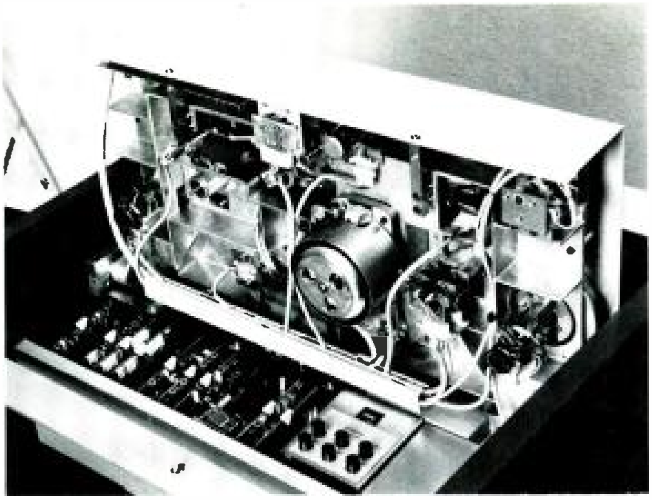


Figure 2. All mechanical elements are accessible.

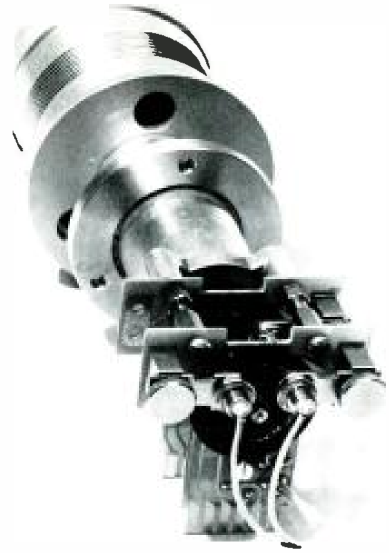
Such a servo logic system requires suitable input signals. These are supplied by transducers which are also referred to as sensors. Among these is the tape motion and direction sensor. It contains industrial lamps with extremely long lamp life and is so designed that even if a lamp fails during operation, no harm will be done to the recording or the machine; existent functions remain in effect until the *stop* button is pushed or the tape runs out.

The electronic servo control of tape tension begins with the two tape tension sensors. Their output signals influence the spooling motors even during the fast winding modes. During the editing mode these tape tension sensors are blocked against rotation by solenoids, facilitating maneuvering of the tape by hand.

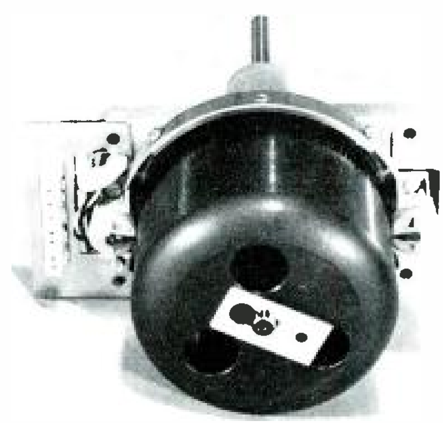
For the multi-channel versions of the A-80, the 4-, 8-, and 16-channel amplifiers are combined in a turret toward the back and above the deck. They were so dimensioned as to allow the mounting of two channels side by side. Each channel of electronics contains nine plug-in cards: record preamp, record line amp, playback preamp, sync preamp, playback line amp, sync line amp, control logic card, v.u. meter and voltage stabilization. In addition, there are the two adjustment modules for record and playback.

Each recording channel has been arranged into a chain consisting of preamps, calibrating modules and line amplifiers. The preamplifiers contain separate channels for each tape speed (7½/15 or 15/30). Switching to CCIR or NAB equalization is done in the second stage. Wherever audio or r.f. are switched, it is done by means of contactless switches made of f.e.t. elements. In the r.f. circuits controlling record and erase functions, diodes provide time delay to give smooth and click-free on and off switching. The 80 kHz erase frequency is phase locked to the 240 kHz bias frequency.

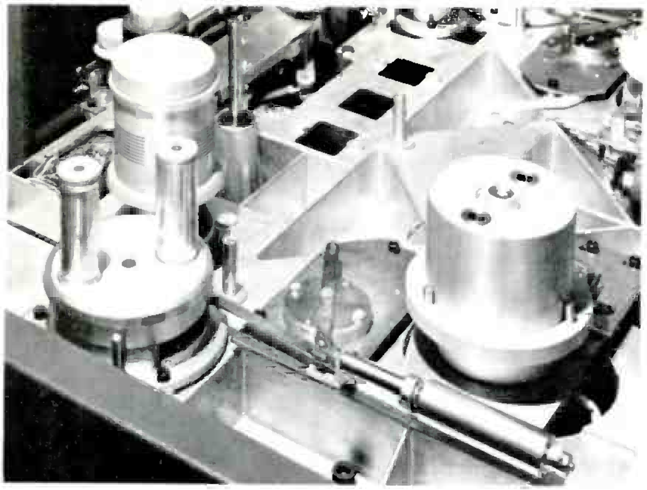
The playback channels also contain separate branches for the two tape speeds. All operating parameters of the channel are controlled through a selector switch on the module or from a remote location through a contact-free control logic element. To mention some statistics, each channel is equipped with 32 bipolar silicon transistors, 17 f.e.t.'s, 18 hybrid circuits, 2 i.c.'s and 21 diodes. The building block system used here assures that the A-80 will remain state-of-the-art equipment for years to come, capable of fulfilling not only standard requirements but a myriad of special needs such as film synchronous-, VTR synchronous- and machine-to-machine synchronous operation. People are already buying 24 and speaking of 32-channel machines. ■



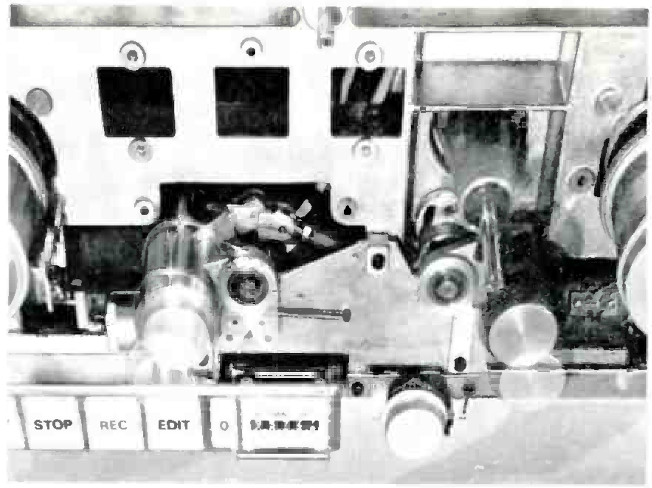
The sensing element for tape motion and direction is combined with the right rotating roller. It drives perforated disks whose motion is sensed photo-electrically. The output signal of this sensor informs the tape motion logic of the motion of the tape and simultaneously provides the control pulses for the stepping motor of the tape timer which indicates the running time of the tape in hours, minutes and seconds independently of the tape speed setting of the machine.



The A-80 uses a non-synchronous capstan motor with large inertia to provide power voltage and frequency fluctuation free performance. The two pickup heads, to the right and left of the outside rotor, sense the frequency of the milled out slots passing them, thereby providing an r.p.m. dependent signal which is processed to provide a correction signal for the motor drive electronics. The use of two magnetic pickup heads compensates for any inherent errors in the slot milling process. By means of this drive system, the A-80 may be operated on either 50 Hz or 60 Hz without any adjustments.



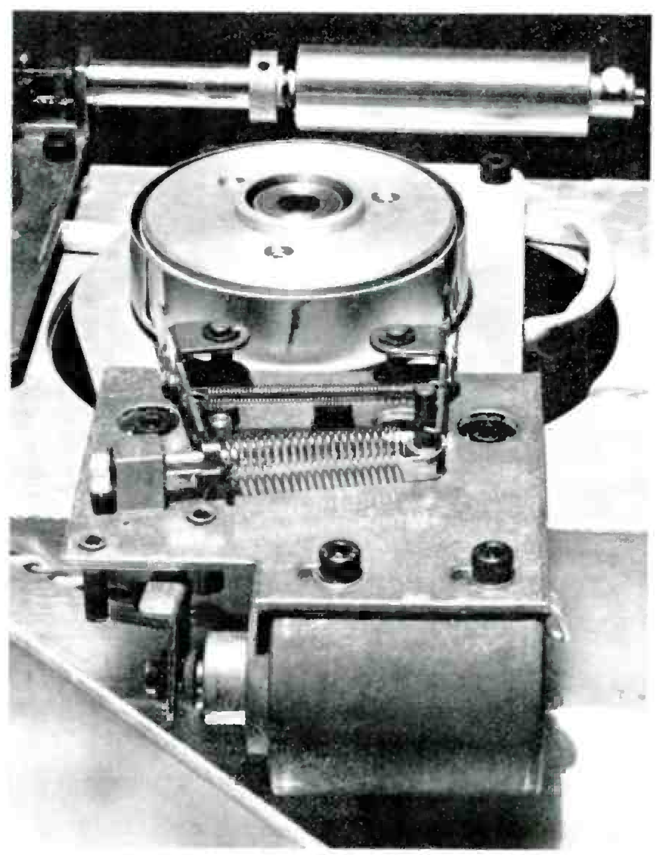
Two contact free sensors are provided for controlling the torque of the spooling motors. The one shown at the left of the above picture, is for the take-up motor. Each contains a precision potentiometer which keeps the servo input voltage proportional to tape tension. Behind the two slender rollers of the tape tension sensor is the larger rotating roller. Bottom right is the damping element and right center the large take up motor hub for the reel.



The pressure roller and flutter idler are electro-magnetically controlled and pneumatically damped. The double exposure of the roller assembly mounted on the main chassis shows the rollers and their levers in their two positions: in the stop mode, with tape clear of heads, and the normal running mode.

The photoelectric switch located next to the left rotating idler provides information regarding the presence or absence of tape. This element consists of a lamp with lens at bottom left, the photo-element in the second cylinder and a mirror system within the slender vertical column. Only in the absence of tape does the light reach the photo element via the mirror located behind the tape.

During normal operation the spooling motors utilize d.c. braking. This picture shows the mechanical servo-brakes which are solenoid operated and which function only when tape is at a stand still, when editing, or when power fails. Braking action is adjustable by means of the spring at the front. Servo ratio is 1:5.



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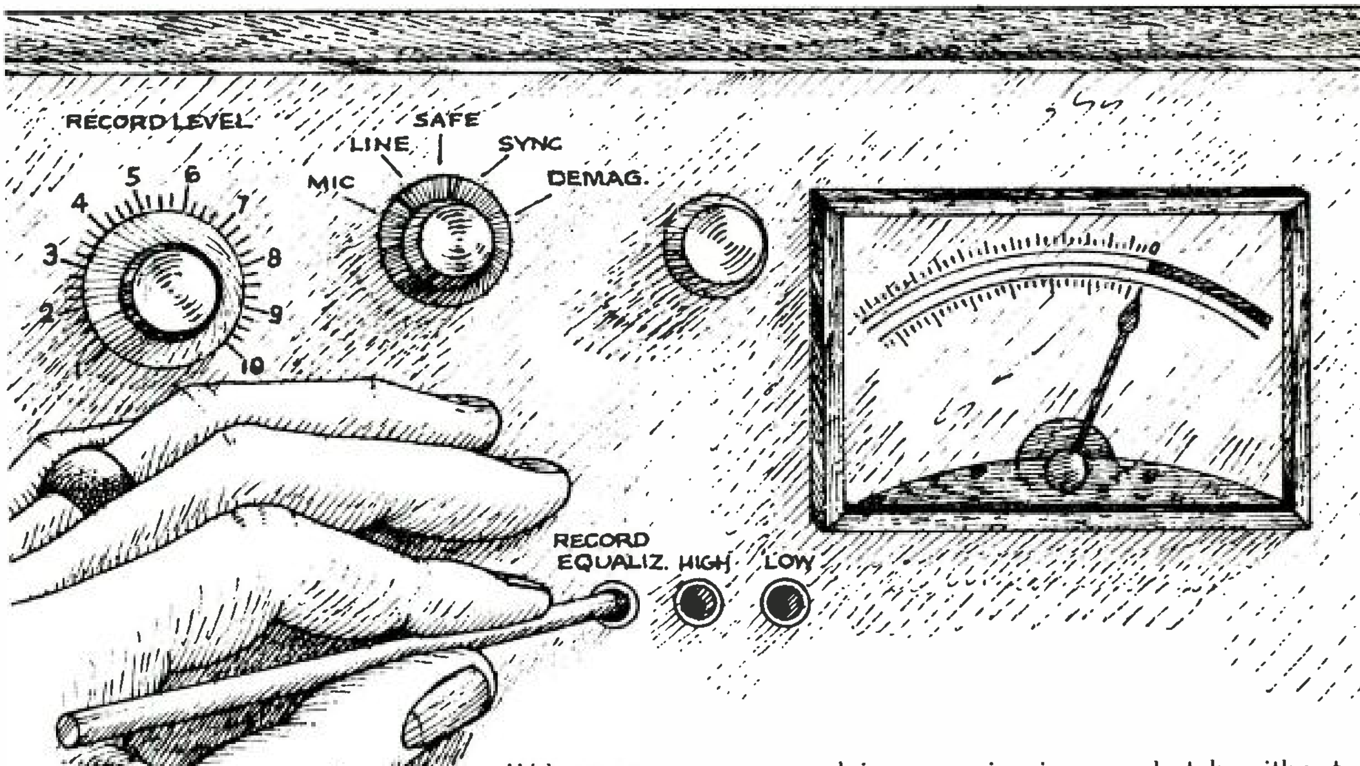

We're a new mastering tape formulation, so the limits of older tapes don't apply to us. Initially, our extra quality needs some getting used to. To upgrade your original recordings, you'll have to adjust your equalization and bias controls to our specifications. That's not much work, but it's necessary. And it's worth it.

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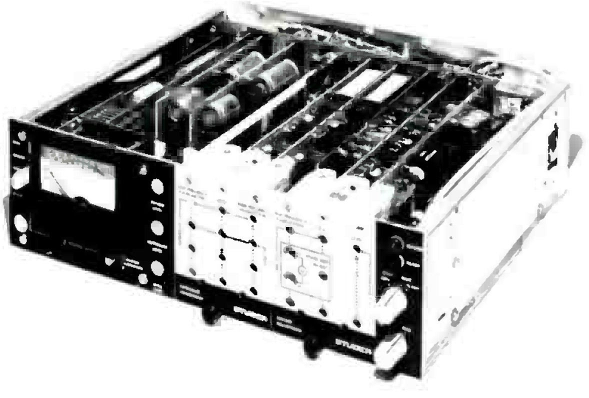
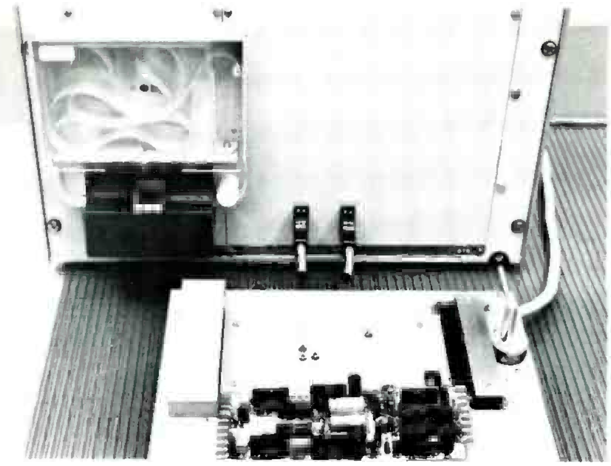
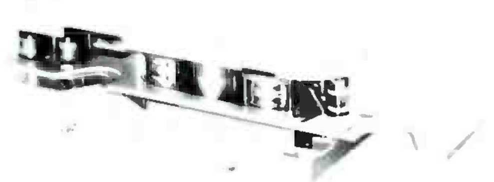


The electronics for each channel of the A-80 are combined into a single plug-in module. Especially noteworthy are the adjustment modules for playback and record which are plugged into the respective amplifier cards from the front. This permits accurate settings for any type of tape or for various head assembly configurations. At the left, next to the light panel area of the adjustment modules, is the v.u. meter with test range switch and push button for operation and calibration.

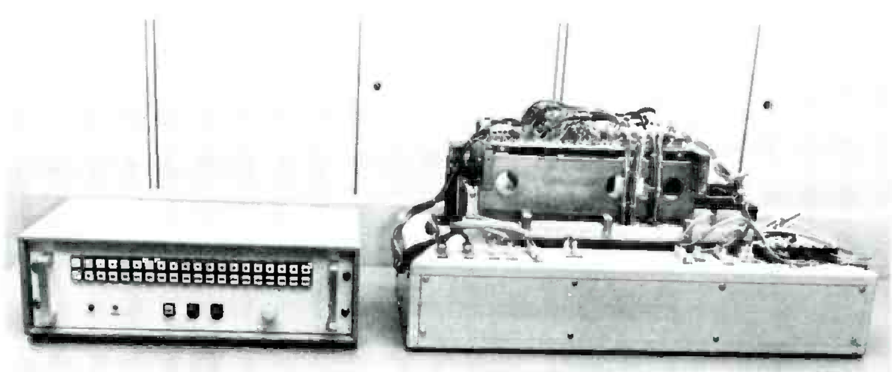


The time consuming manual testing of close tolerance complex amplifier prints in the Studer A-80 has been replaced by the automated tester shown in this figure. Special adapter jigs provide access not only to the input and output connections, but also to test points on the print itself. This allows testing not only of the amplifier parameters, but in addition provides d.c. voltages, operating parameters and equalization data within close tolerance.

This automatic tester not only provides time advantages, but is more precise and more reliable. No human being could be trusted to measure to a tolerance of $\pm$ 0.1 dB over a long period of time. The invariable result of monotonous tasks such as this is fatigue and with it inaccuracy and errors. This automatic tester, on the other hand, measures 96 separate parameters in 3 minutes without any possibility of error.



This is the plug-in head assembly for a 2-track A-80 unit. Noteworthy is the dual erase head which provides individual track erasing without leaving an unerased center guard band. Both the record and playback heads are of the 0.75mm guard band type which is standard for stereo machines in Europe. This provides 30 per cent greater track width without any decrease in track separation! This is due to the very special "chevron" construction of the pole pieces. Between record and playback head is located an anti scrape flutter idler.



The entire wiring harness for the tape deck digital control system with all of its wire wrap and Molex connector terminals are tested by means of this electronic test unit. Wiring errors are indicated by lamps which in turn reference to a computer written wiring list making determination precise and rapid.
The test unit consists of a Studer developed control unit (left) which checks up to 400 connections on the test jig shown at right. The test adapter contains a matrix with 1100 diodes!

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1971
D-124

1954
D-19

1971
D-190

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AKG-17

MARVIN SOLOFF

Setting Up a Professional Recorder

This article details a sophisticated technique that can be used to exactly suit a specific tape to a specific machine.

ABOUT TWO YEARS AGO, we were trying to devise a method of showing the recording qualities of our just introduced UD cassette tape. We discussed and rejected sound listening tests as being too subjective—in that individual hearing differs somewhat between observers, and that an extensive setup with amplifiers, speakers, headphones and such would limit portability. We finally hit upon a demonstration technique that would show what we wanted to show and that could be run by untrained personnel. This was the Maxell Tape Clinic, which has been shown all over the United States, Japan, and Eastern Europe.

Essentially what we did was couple a logarithmic sweep signal generator to a dual-trace storage oscilloscope to produce an instant frequency response curve. We used a Hewlett-Packard 141B/1420/1405A 'scope combination, giving us the dual trace and storage facility, and the Hewlett-Packard 3300/3305A function generator which is one of the only instruments available producing a logarithmic sweep.

We generated a 20 Hz to 20 kHz tone burst at approximately 0.7 second duration and feed this swept signal both to the input of the upper trace on the 'scope and to the record input of a tape deck. At this point we now had a signal source producing a perfect log sweep and a method (the dual-trace storage 'scope) for comparison of the generated trace with the recorded trace. In the initial uses of this system with cassette decks, we found that we could not only demonstrate relative tape quality, but we could also check very quickly the frequency response of the amplifiers and to some extent, head alignment. The head alignment was difficult because the cassette machines have only a combination record/play head—nevertheless, a misaligned head would produce a specific trace pattern when used with a tape of known properties. The interconnect set-up used for cassette decks is illustrated as FIGURE 1.

In this test, which we call "A" test, the signals move across the screen, from left to right. No attempt is made to synchronize or calibrate the trace because our requirements were specifically comparisons rather than actual measurement.

Because we showed the tape clinic in hi-fi shops to the audiophile trade, we began to have requests to demonstrate the clinic with audiophile reel-to-reel machines. Again, we used the same basic 'scope/generator combination, but hooked it up to synchronize the trace and give us more accuracy in calibration. FIGURE 2 is the interconnect diagram for reel-to-reel analysis or "B" test. Here again, we were able to view the response of the record and playback amplifiers of the deck, the total over-all frequency response, the bias level and the record head azimuth all on the same trace. The various points of interest of the trace are shown.

Marvin Soloff is national sales manager, professional products division for Maxell tape.

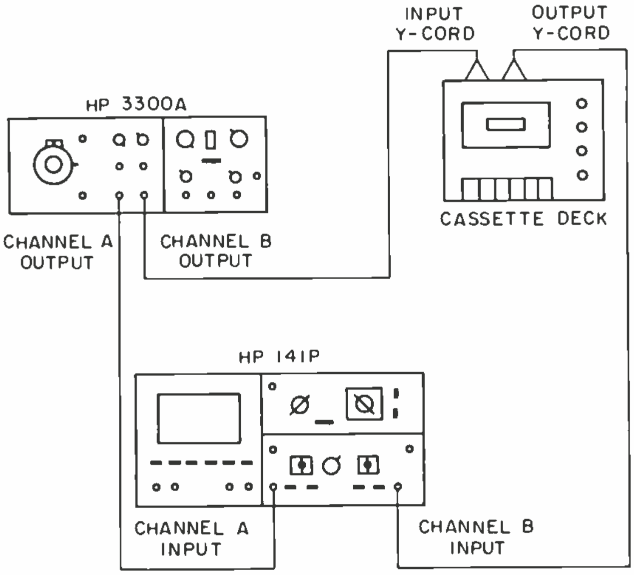
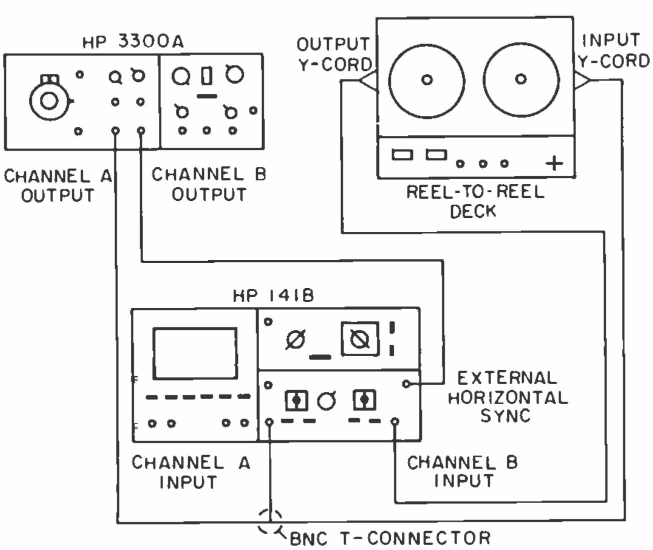


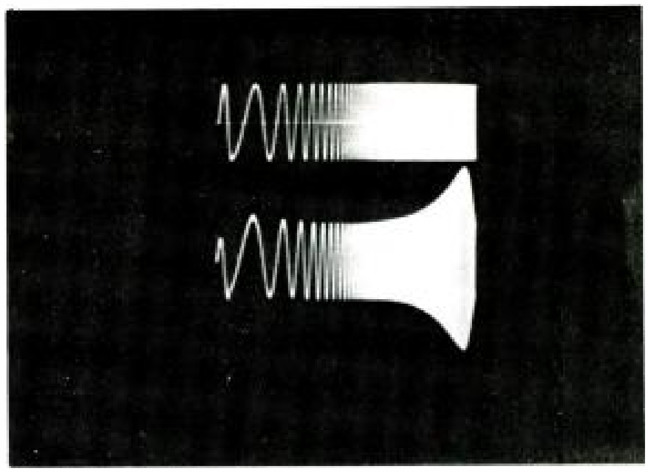
Figure 1. The "A" test referred to in the text, used for cassette machines.

In the past several months, we have begun using the 'scope/generator combination to demonstrate Maxell UD Mastering tape to several of the recording studios on the east coast. Since Maxell UD 50 requires slightly different equalization than the standard 3M tapes, we have developed a specific method of dual equalization that enables a professional mastering tape user to accurately match several mastering tapes to his machines. Good studio practice demands that a specific tape be matched electrically for bias and equalization to each machine it is used on. Most of the newer audiophile machines have made provision for selectable bias and equalization to cover several different makes of recording tape. This selection is done through a switch mounted on the front panel of the deck controlling sets of bias and equalization trimmers. As tape technology advances, the traditional bias and equalization points (3M 111, 3M 202) may no longer apply, so the convenience of having a fast method of setting bias and equalization is becoming very necessary.

The specific method for a dual equalization set-up is as follows: Set up the generator and dual-trace so that the traces can be synchronized. Obtain a fresh reel of the tape you currently use as primary supply, obtain a good condition test tape—either Ampex, STL or Magnetic Reference Lab. Allow the system to come to stability for about 20 minutes.

Figure 2. The "B" test, useful for complete adjustment of a professional machine.



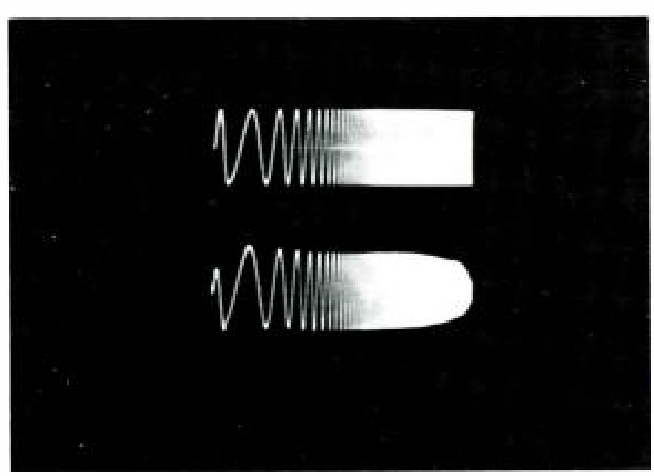


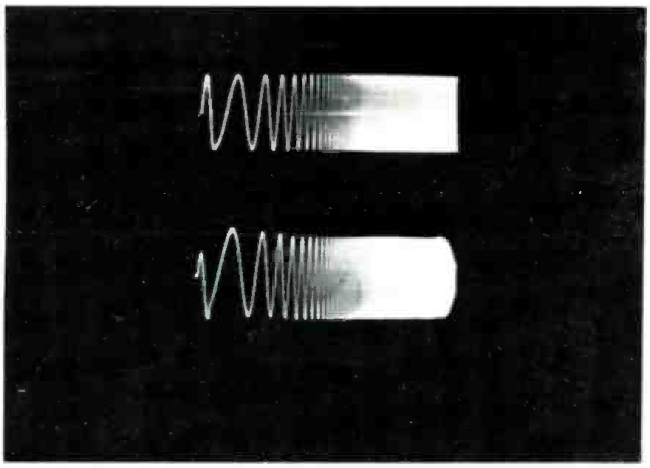
A tape recorder using tape that is underbiased by 2 dB.

Clean and demagnetize the head assembly, guides, limit switch arms etc. Thread the NAB alignment tape onto the deck and set into playback mode. Align the play head while watching both the v.u. meter and 'scope. Later we will record a special sweep tape for this purpose—but for initial calibration we start with the NAB standard alignment tape. Adjust the azimuth at the alignment frequencies as specified on the tape. Once the play azimuth is set, replace the alignment tape with the fresh reel of primary supply. (In the accompanying illustrations we are using 3M type 206 and Maxell UD 50). The deck is set into the record mode and the monitor is switched to play so we can read the signal off the play head. Set the gain of the record input to —5dB. The log sweep signal is now seen on the lower trace of the 'scope. This is the actual response curve of the system in the present state of adjustment.

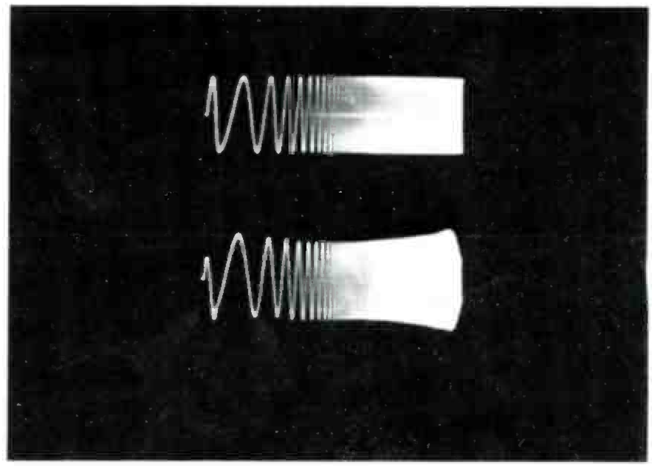
Adjust the record head azimuth for maximum output and zero phase error. Phase errors are more prevalent with multi-track heads and can be adjusted out by splitting the incoming signal with a Y-cord and feeding the both sets of heads simultaneously. As the azimuth adjustment is changed, the phase errors are swept out to beyond the

In this case the recorder is overbiasing the tape by 2 dB.





Ideal alignment of a machine. Traces for properly set up machines using 206 or UD 50 are identical.



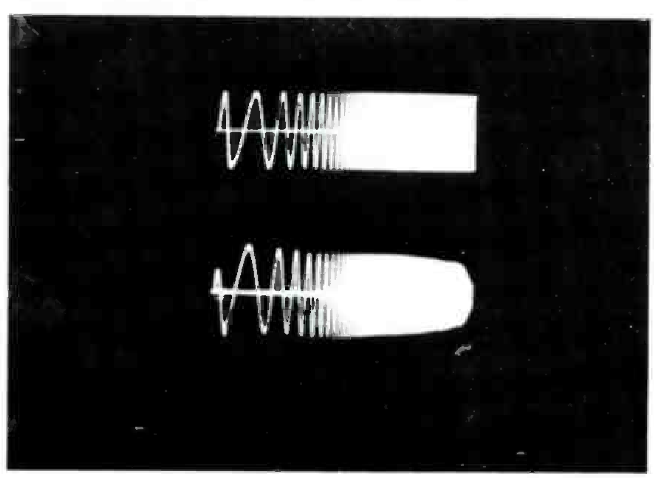
A machine aligned for 206 and using UD 50.

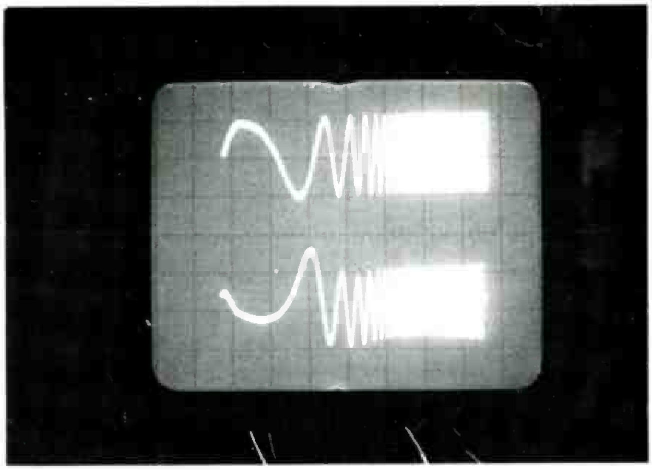
frequency range of the head. Generally, these phase errors are never picked up by standard alignment techniques, and so go unnoticed. These null points occur at odd frequencies such as 4600 Hz or 6500 Hz and the null does indicate a total loss of signal at those frequencies. Once the record head alignment is set, the bias is adjusted for maximum bias level. By observing the trace on the screen, the relationship between bias and frequency response can be seen: too little bias will distort the curve, too much will reduce the output. Once the peak bias is set, adjust the high and low frequency equalizers to produce a flat response curve on the lower trace of the 'scope. If, at this point, the trace is not perfectly flat, try to readjust the bias slightly. Some minor improvements can be made by overbiasing slightly, but the output of the tape drops severely affecting the overall s/n ratio. At this point, every effort should be made to trim the response curve for flat frequency response.

This may be accomplished by several methods: Loading the head circuits slightly with suitable value resistors, or lowering the value of the equalization circuit capacitance, or rerouting lead dress from heads to preamp circuit. After the response curve is trimmed to a flat response, as indicated on the 'scope, several minutes of the tone burst can be recorded and kept as a reference tape for the particular brand of tape under primary use.

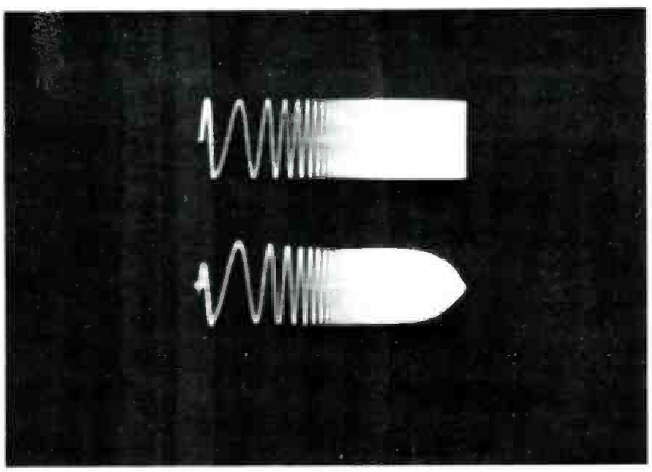
Now that we have established a primary reference on one tape, we will make these adjustment points. Using a small bottle of enamel and a fine brush, mark the top of the adjustment screw slot with a point of enamel. Place a marker dot directly above this on the panel of the machine. Do this for bias and both high and low equalization for each speed. Allow the enamel to dry. Now, with the machine set for primary source, replace the primary tape with secondary tape (here we're using Maxell UD 50). Place the deck in record mode and monitor the playback head on the lower trace of the scope. If, for example we are resetting for Maxell UD-50, you will see a sharp increase in both output and high-end frequency response. Carefully swing the bias adjustment to see if any appreciable change occurs. Generally, biasing between tapes

A machine aligned for UD 50 and using 206.





Incorrect eq at 10 kHz.



Incorrect azimuth alignment.

from different manufacturers is quite close, and, allowing for manufacturing tolerances, the error could be as high as 5 per cent. Practically, this is the same as not changing the bias, but it is good practice to check bias with each reel of tape put on the machine.

If the change of bias does not radically affect the sweep trace, leave it set opposite the red dot on the panel. If the bias has to be changed considerably, find the optimum bias point and mark the panel, this time with a dot of a different color.

Now, with the tape still running, trim the high and low equalization pots and observe the 'scope trace for flat equalization response. Mark these positions with a color dot. Do this for each speed. Check by observing the response trace on the 'scope. We have now marked the machine for dual bias-dual equalization and can change from tape to tape at will.

With certain older machines it becomes difficult to pull down the high-end equalization far enough. Generally, we find that these machines have a bit too much capacitance in the r.c. equalizer network. Many older machines can be simply and quickly modified for 3M 206 and Maxell UD-50 by reducing the capacitance of the eq trimmer. In certain instances where a compression trimmer capacitor is used, removing one wafer of mica from the trimmer will give enough capacitance drop to accommodate the new hot tapes. ■

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USED EQUIPMENT SALE—1. Neumann Mono Cutting System, complete with Helium Cooled ES-59 Cutterhead Spencer Microscope, Neumann Cutting Amp (in rack wired for stereo) and Gast Suction Pump (Price on request); 2. Magnasync Mark IX 35MM Mono Film Recorder in 7' Rack $950.00; 3. Fairchild Mono Limiter $250.00; 4. Altec 9473A Dual Limiter $350.00; 5. Capps Condenser Mike with Power Supply $50.00; 6. Altec Condenser Mike with Power Supply $50.00; 7. 4-Melcor CL-20 Limiter/Compressors at $100.00 EACH; 8. Universal Equalizer VE100-Klein & Hummel (Price on Request); 9. Ampex Mono and 2 Track Stereo Tape Machines in good condition (Prices on Request); 10. Ampex Tape Machine Electronics 300-350-351 and 352 (Prices on Request); 11. Scully 8 Track Recorder in Scully Cabinet (Price on Request); 12. 4-Spring-type Echo Chambers 600 ohms in and out on Cannon Connectors in 30" Rack on Wheels (Price on Request); Contact: **Irv Joel, A&R RECORDING, INC., 322 W. 48th St., NY 10036. Telephone (212) 582-1070.**

SCULLY TAPE RECORDERS—one to twenty-four track and model 270 auto players, many models in stock for immediate delivery. SCULLY LATHES—Previously owned and rebuilt. Variable or automatic pitch. Complete cutting systems with Westrex heads. MIXING CONSOLES—Custom designed using Weigand Audio Lab modules. From $7,000.00. **Weigand Audio Laboratories, R.D. 3, Middleburg, Pa. 17842. Phone (717) 837-1444.**

AMPEX PARTS, head stacks and head assemblies, complete inventory. Write for price quotation. **Accurate Sound Corporation, P.O. Box 2159, Garland, Texas 75041. Telephone (214) 278-0553.**

EXCLUSIVELY IN USA "Satin" moving coil cartridges. Impedance matches magnetic input. M14LE (elliptical) $99.95. M14LX (Shibata) $129.95. Send check to **Michael-Scott Enterprises, Room 24, 6056 West Broadway, Minneapolis, Minn. 55422.**

ONE STOP FOR ALL your professional audio requirements. Bottom line oriented. **F.T.C. Brewer Company, P.O. Box 8057, Pensacola, Florida 32505.**

PRESTO 8N DISC RECORDER. Equipped with Grampian recording head and Gotham Power amplifier. Best offer or trade for Ampex 350-351. **Northwestern Incorporated, 011 S.W. Hooker St., Portland, Oregon 97201.**

WANTED

OLD MICROPHONES 1920 to 1940. All makes and models. Also literature. Write **Bob Paquette, 443 N 31st Street, Milwaukee, Wis. 53208.**

DO YOU SEEK REPRESENTATION in New England States? Experienced audio representatives with wide contacts seeks additional audio lines. Highest references. Write or call **Frank Barmakian Sales, 100 Hatherly Road, Waltham, Mass. 02154. (617) 894-4849.**

WANTED: two Marantz Model 9 power amplifiers in good condition. Send particulars to **Box 835, Great Neck, N.Y. 11021.**

EMPLOYMENT

MAINTENANCE ENGINEER. Large three studio operation (24-track) with high-speed duplication facilities. Full knowledge of Scully and Ampex recorders, console systems and audio electronics required. Good pay. Great people. Send complete resume including personal information to W. Craig Kenney, **Flite Three Recordings Inc., 1130 East Coldspring Lane, Baltimore, Md. 21239. (301) 532-7500.**

EXPERIENCED DISC MASTERING ENGINEER for well known cutting room in New York City. Top Salary and benefits. Write to **Box 2-A, db Magazine, 980 Old Country Road, Plainview, N.Y. 11803.**

CLASSIFIED

FOR SALE

AMPEX ONE INCH VIDEOTAPE RECORDER, model 7500, excellent condition, 12 reels tape, service manual. $950.00. **Ophthalmological Electronics Laboratory, Southhampton Hospital, Southhampton, N.Y. 11968. (516) 283-5835.**

SOLID-STATE AUDIO MODULES. Console kits, power amplifier kits, power supplies. Octal plug-ins—mic, eq, line, disc, tape play, tape record, amplifiers. Audio and tape bias oscillators. Over 50 audio products, send for free catalog and applications. **Opamp Labs. Inc., 172 So. Alta Vista Blvd., Los Angeles, Ca. 90036. (213) 934-3566.**

HAECO announces complete repair service and overhaul for all Westrex cutterheads. Conversions of 3D-II and older models to higher performance standards and reliability. Helium cooling systems and hi-temp coils can protect your investment. Repair insurance program available. Rapid service. Lower cost. **HAECO, 14110 Aetna, Van Nuys, California 91401.**

AUDIO EQUIPMENT, new and used. Custom consoles built to your specifications using the components of your choice. Whether you're building a new studio or remodeling your present one, check us first for a package price. **Amboy Audio Associates, 236 Walnut Street, South Amboy, N.J. 08879. (201) 721-5121.**

FOR SALE: Bulk quantities of used ¼, ½, and 1 inch tape. **Vanguard Records, 71 West 23rd Street, N.Y. 10010. (212) 255-7732.**

AUDIOTECHNIQUES, INC. WANTS TO BUY your used Scully Model 280 series tape recorders, any width from quarter inch to two inch. Write or phone Bob Berliner or Ham Brosious giving condition, serial number and configuration. **Audiotechniques Inc., 142 Hamilton Avenue, Stamford, Conn. 06902. (203) 359-2312.**

SAVE ON YOUR STYLUS COSTS! World's finest recording styli for all Westrex 3D models and HAECO SC-2. $12.80 unwired, $13.80 wired. Quantity purchases at additional savings. Satisfaction guaranteed. Send check or money order with your order to **HAECO, 14100 Aetna St., Van Nuys, Ca. 91401.**

LARGE RECORDING STUDIO FOR SALE. Fabulous location and great sounding studio. Boston area, 7000 square feet. Air-conditioned and containing many pieces of good recording equipment and instruments included. Price reasonable. Write **P.O. Box 8, Newtonville, Mass. 02160 or call (617) 969-8295 or 482-8581.**

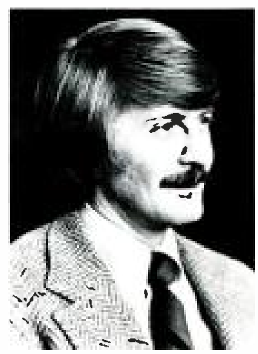
PEOPLE, PLACES, HAPPENINGS

Croft

Fagersten

Anderson

● No less than three new appointments are announced by **Altec Corporation. Doug Croft** will cover northern California, Nevada, Utah, Hawaii, and Alaska; **Gerald Fagersten** will cover the Dakotas, Minnesota, Wisconsin, upper Michigan, and northeastern Illinois; **Don Anderson** has been assigned to cover New Mexico, Texas, Oklahoma, and Louisiana. Each will have the title of regional manager and will be in a position to interface between the company and its contractors.



Feitz

● **Bill Feitz** has been named advertising and sales promotion manager for **Switchcraft, Inc.** In the announcement by **Clyde J. Schultz,** vice president of marketing, it was noted that Bill Feitz "brings to Switchcraft broad experience in electronics sales promotion and advertising. He will be responsible for national advertising, sales promotion, catalog publication, and trade shows." He was formerly with the consumer equipment division of **Ampex Corporation** where he was merchandise manager.

● An announcement from **Memorex Corporation** tells of the appointment of **Michael B. Martin** as technical director of the consumer products division. In making the announcement, **Robert Jaunich II,** v.p. and general manager of the division noted that "Mike Martin is our logical choice to succeed **Eric Daniel,** who is retiring. He has worked with Eric on all phases of consumer products development." Mike Martin brings a total of 23 years of magnetic tape development to this position.

● **Maxell Corporation** will be moving to a new location as this appears. The facility will be at 130 West Commercial Avenue in Moonachie, New Jersey. The ground space in the new plant will be 25,000 square feet, with a 15,000 square feet of building space, a fifth of which will be devoted to showroom facilities and office space. The balance will be devoted entirely to warehousing for improved service to customers in shorter time.

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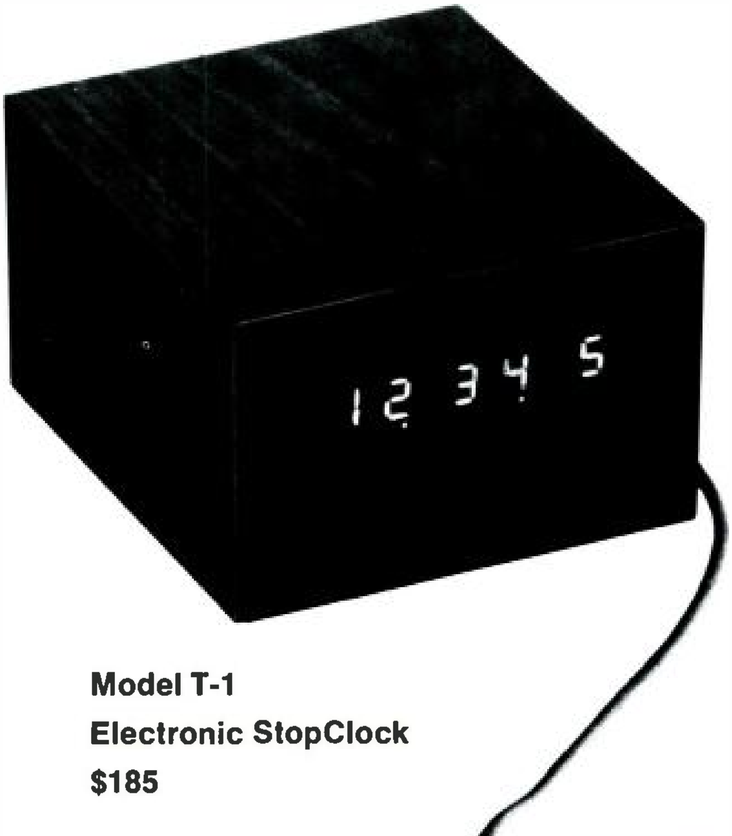
StopClock

A New, Accurate, Digital Timing Instrument for Recording Studios, Broadcasters, and Other Demanding Applications



Model T-1

Electronic StopClock

$185

Timekeeper is proud to introduce a new inexpensive *Electronic* StopClock—a compact instrument featuring an easily-read visual display.

Only 5⅛″ wide x 3¼″ high x 5½″ deep, it uses modern digital circuitry to provide accuracy of a very high order with exceptional long term stability. The large ⅜″ high, seven-segment numerals can easily be read from a distance of more than 15 feet. Maximum count is one hour (59:59:9).

Three remote-mounted push buttons are used for manual control: START, STOP, and RESET. These buttons may be placed in a console, operating desk or any convenient location. The clock may be remotely located in the equipment, or on a desk or table. (A mounting flange is provided.)

Operation is similar to any conventional stopwatch. The green button starts the clock; the red button stops it. The black button resets it to zero. These may be depressed in any order, or all at once, without damage to the clock. If it is desired to start the clock by releasing a button rather than depressing one, the green and black button are pressed simultaneously. When the black button is released, the clock will start automatically.

The accessory plug on the rear panel may be used for all remote operations. All BCD information is available at this plug for accessory units such as digital printers, slave units, etc.

The Model T-1 is supplied for 120 volt 60 Hz operation, in an attractive simulated walnut grained enclosure with a red lucite face. However, 120-volt 50 Hz operation is available at no extra charge if so specified at the time you place your order.

The Model T-1 is priced at $185.00. As with all Timekeeper products, it is fully guaranteed to meet with your complete satisfaction, or your money will be promptly refunded. It is guaranteed for one year against any defects in manufacturing.

The Timekeeper Electronic StopClock is a must. More than a high quality timer—it provides the added convenience of full visual display, high accuracy and stability plus operational flexibility. Order one soon. You will be delighted with it.

TIMEKEEPER

P.O. Box 835, Great Neck, N.Y. 11021

Please send me ____ Model T-1 Timekeeper Electronic StopClock(s) at $185.00. N.Y.S. residents add 7% sales tax. Add $1.00 shipping per order. I enclose $________

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Built better. Performs longer. Costs less.

Wire windings are OUT, conductive plastic is IN for high performance audio controls. With its new Series 300 SLIDELINE™, Duncan Electronics replaces noisy, rough and "grainy" wire elements with smooth, noise-free RESOLON® conductive plastic which actually *improves with use!*

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