AUDIO

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- Musical Broadcasting in the 19th Century
- Get to Know the Decibel

Violinist Isaac Stern studies score while listening to records on his hi-fi system

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June, 1967 Vol. 51, No. 6

AUDIO

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AUDIO Articles

AUDIO Reviews

AUDIO Profiles

AUDIO in General

AUDIO (title registered U. S. Pat. Off.) is published monthly by North American Publishing Co., I. J. Borowsky, President; Frank Nemeyer, C. G. McProud, and Arthur Sitner, Vice Presidents. Executive and Editorial Offices, 134 North 13th St., Philadelphia, Pa. 19107. Subscription rates—U.S. Possessions, Canada, and Mexico, $5.00 for one year; $9.00 for two years; all other countries, $6.00 per year. Printed in U.S.A. at Philadelphia, Pa. All rights reserved. Entire contents copyrighted 1967 by North American Publishing Co. Second class postage paid at Philadelphia, Pa., and additional mailing offices.

REGIONAL SALES OFFICES: Sanford L. Cahn, 663 Fifth Ave., New York, N. Y. 10022; (212) 753-8824.
Richard Reed, 205 W. Wacker Drive, Chicago, Ill. 60606; (312) 332-3910.
Leonard Gold, 1900 Euclid Ave., Cleveland, Ohio 44125 (216) 621-4992.
Jay Martin, 9350 Wilshire Blvd., Beverly Hills, Calif. (213) 273-1495.
REPRESENTATIVE: Warren Birkenhead, Inc., No. 25, 2-chome, Shiba Hamamatsu-cho, Minato-ku, Tokyo, Japan.

AUDIO, Editorial and Publishing Offices, 134 N. 13th St., Phila., Pa. 19107
Postmaster: Send Form 3579 to the above address.

Coming
Articles

Audio Measurements Course by Norman H. Crowhurst. The concluding installment discusses measurement methods to follow when connecting multiple speakers.

Forum on Microphones and Headphones. A roundtable discussion with manufacturers on the attributes of these components, guides to using them effectively, and so on.

The NAB Tape Recording and Reproducing Standards by Herman Burstein unveils the wealth of information buried in the standards by comparing them with the old NAB standards and those of the RIAA.

Profiles . . .

Sharp HA-660 PRO headphones
Heathkit AD-16 tape recorder
Fisher XP-55 speaker systems

About the Cover

Isaac Stern, violin virtuoso, is pictured in his study surrounded by the tools of his profession: violin, piano, and component high fidelity system. The latter is housed in attractive wood chests. Story on page 30.

AUDIO CLINIC

Joseph Giovanelli

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

FM tuning Difficulty

Q. Five years ago I built an FM tuner from a kit. I have had no trouble with it since it was completed until now.

Recently, however, a peculiar change occurred. When the tuner is turned on now, it receives only one *station. Turning the tuning knob has no effect whatever, even though the pointer moves along the scale. The reception is exceptionally loud and clear.*

I assume that the trouble has occurred in the "front end" which was originally aligned at the factory. I am reluctant to open this portion of the set.

Are there any tests or procedures you can suggest which I might follow before sending the set for repair?
Murray Schwartz, D. D. S., Nyack, N. Y.

A. Before we decide that the front end is at fault, I believe that we should examine the tuner mechanically. It is true that the pointer moves across the dial as it should. Does the tuning knob act to turn the variable capacitor as it should? It is possible that the drum attached to the variable capacitor has worked loose and does not, therefore, cause the shaft to turn. If you can see the variable capacitor, turn the tuning knob; even if you can not see the capacitor, note whether the drum turns. Note if the capacitor *shaft* turns. If not, you probably can repair the trouble merely by tightening the set screw which holds the dial drum to the capacitor.

If it happens that the drum was originally welded to the capacitor's shaft, you will have a more difficult time. You may be able to resolder the drum in position again. Make sure that the pointer lines up properly before soldering the drum. There may be some leeway in the dial stringing arrangement which will enable you to compensate for misalignment of the pointer at the time you solder the drum in place. The pointer can, under these circumstances, be slid to correspond with the proper calibration as determined by a station being received.

If the dial drum works correctly and turns the variable capacitor, we do have an odd problem. Check all tubes associated with the front end. Perhaps the oscillator is not oscillating; perhaps the mixer or the r.f. stage is oscillating at a single frequency. This beats with your received station in such a manner as to produce the 10.7-MHz i.f. signal probably used in your tuner. I have seen such things take place, but not often. Replacing tubes usually solves the whole. If this does not work, you may possibly have to clean the variable capacitor contacts.

You may have to remove the variable capacitor from the set altogether if cleaning can be accomplished in no other way. Use a small amount of contact cleaner on the wipers—the springs which enable the moving element of the capacitor to make contact with the case, or frame, of the unit.

This is an extreme procedure and it is probably not the solution to the problem. I have seen this in one or two instances where the environment in which the tuner was located was very dusty and greasy. The wipers simply did not return the rotor sections of the capacitor to the frame. In one instance I had to bend the wipers so that they would exert more force against the moving rotor sections.

Before trying this procedure, check all voltages to see if they are close to what they are supposed to be. The rectifier system may not be working correctly, leading to a low voltage around the entire system. This voltage might be low enough to result in the oscillator dropping out of oscillation.

If the voltages are correct except for those around the oscillator-mixer section, you will know that you must concentrate your attention on such items as the decoupling resistors and bypass capacitors.

If all voltages check out correctly, perhaps the oscillator-plate-bypass capacitor has opened; perhaps the elements in the grid circuit have changed value.

Maybe your difficulty arises from poor contact between the tube-socket pins and their socket connections. This situation often can be cured by squirting a small amount of contact cleaner into the tube socket and by wiping a small amount of cleaner on each tube pin. Then insert and withdraw the tube a few times to obtain a wiping action.

If your tuner is a solid-state device (and it probably is not because of the length of time you have had it), you should replace the oscillator transistor

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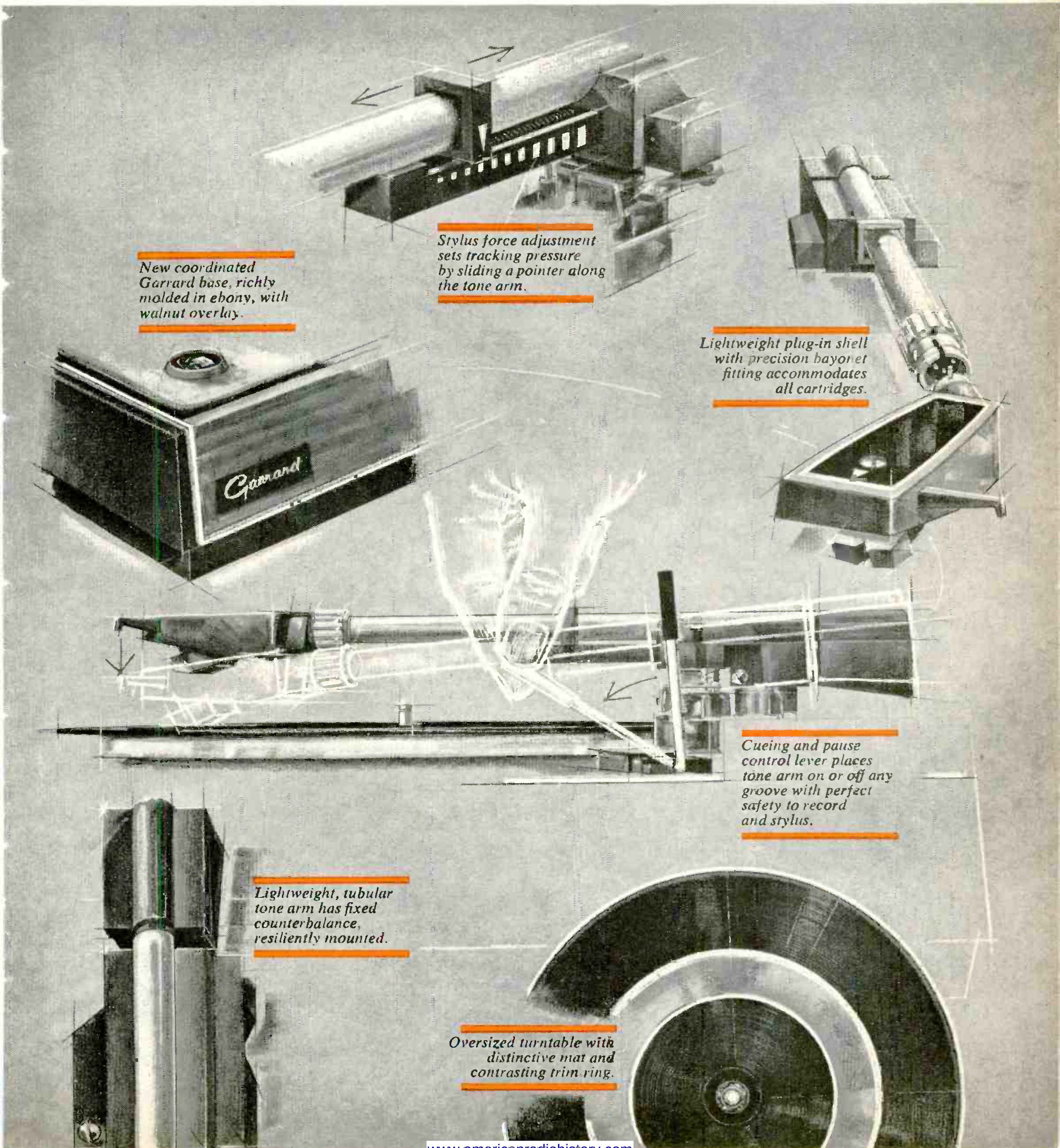

and note the difference in performance. The major cause of failure in oscillator circuits relates to the base-biasing circuit. Often the actual bias voltage must be changed or the impedance of the divider network must be changed before sustained oscillations can occur.

In summary of this section of the question, then, very often the failure of the oscillator to function will result in some other portion of the circuit breaking into oscillation, thereby creating your difficulty.

Ceramic Magnets

Q. Speaker manufacturers and others have turned more and more to ceramic magnets. What are their merits or disadvantages as compared to Alnico V? Ralph E. Day, South Hadley, Mass.

A. Ceramic magnets are indeed being used more and more by speaker manufacturers and others because of the ease with which the ceramic material can be shaped as compared to the more standard and well-known Alnico magnets. Further, the ring shape which many speaker magnets assume is not the ideal shape for Alnico. This shape results in lower efficiency of magnetization of the alloy. Ceramic materials do not suffer from this condition to nearly so marked a degree as is the case with Alnico V.

Duplication of Controls

Q. I am confused by having loudness, treble, and bass controls on both the preamplifiers of my tape recorder and the preamplifier-power amplifier. Where should these controls be set respective to each other when recording or playing back tapes? PFC James E. Summers, APO, San Francisco, California.

A. The duplication of controls on any high fidelity equipment is a problem. Always leave the controls on the tape recorder "flat." Under some circumstances these tone controls may be out of the circuit anyway, and, therefore, their settings will not make much difference. This is especially likely to be the case when recording tapes.

When playing back tape, the volume control on the machine should be set to as high a level as possible without overdriving any portion of the tape recorder electronics.

During recording this volume control must be adjusted to obtain proper signal level on the tape. Of course, in those instances where the machine has a separate playback and recording system, there will be a separate recording-level control, and the chances are that no adjustment need be made of the playback level control once it has been set in accordance with the previous discussion.

All recordings should be made using the tape-out connections on your preamplifier in order to avoid possible feedback. Using these connections will also ensure that the setting of the tone and volume controls on the preamplifier will not affect the performance of the recorder or the quality of the recording.

If your tape recorder has an external speaker connection and if the speaker is operative during playback, a jack should be placed in the external speaker circuit. This jack should be fitted with a resistor equal to the impedance of the speaker, and should have a wattage rating sufficient to take care of the full amplifier power—which might be fed into it under some situations.

While your question dealt specifically with tape recorders, I believe that it really covers duplication of tone controls in general. Other problems which could arise resulting from duplication of controls are those related to the use of home and semi-professional disc recorders which usually have their own tone controls. Adjusting these controls is a matter of obtaining the flattest frequency response. If the tone controls on the disc recorder are sufficient to obtain good response, then the signal probably should be fed into it from the "tape-out" connection on your preamplifier, eliminating the concern over the setting of the tone controls on the preamplifier.

Sometimes it is desirable to connect a portable record player to a high fidelity system. The tone controls in such portables are often very poor. In such equipment it is often best to connect your high-fidelity system directly to the cartridge or to some point in the circuitry ahead of the tone controls. If this is impractical, then set the portable's tone controls for flattest response and do not touch them thereafter. Æ

NEW LITERATURE

Decorating with Compacts

H. H. Scott has an attractive brochure listed as the 1967 Scott Guide to Compact Stereo. This full-color folder includes complete descriptions, specifications, and photos of all of Scott's new line of stereo compacts. Of course it's free. Check 1

Annual Catalog

It's that time of year again. The time for all good catalog publishers to come to the aid of their customers. First to be announced is the 1967 Allied Radio Corp. opus. A total of 514 pages are devoted to high-fidelity components including the Knight and Knight-Kit lines, cabinetry in profusion of type and style, CB equipment both as kits and factory wired, recorders from sub-miniature portables to bulky professional units, console systems, and a multitude of other electronic items from almost as many manufacturers. As with past issues there are pages devoted to receiving and picture tubes, transformers, transistors, relays and timers, switches, plugs and jacks, connectors and sockets, boosters, antennas, converters, wire and cable, lamps, tools, hardware, chemicals, and technical books. The 1967 catalog, No. 260 is free of charge. Check 2

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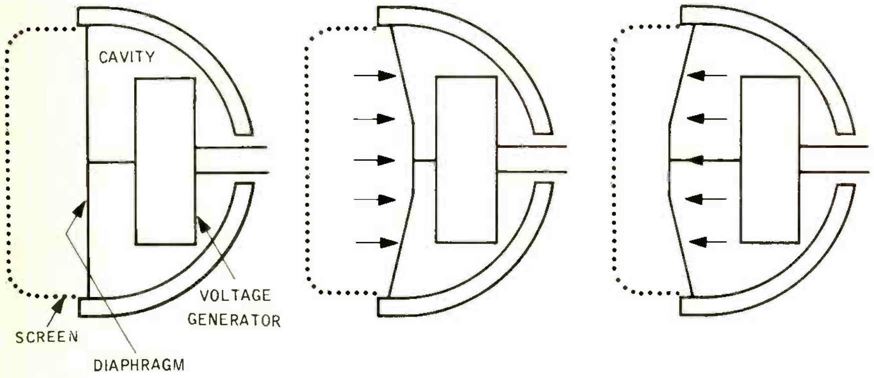

Fig. 1. How a microphone converts the minute motions of the air that are sound waves into an electrical signal. (A) No sound. (B) Compression wave; (C) Rarefaction wave.

We've been talking all along about sound waves and electrical waves pretty interchangeably. But as we say back in the opening chapter, we need special devices, called "transducers," to convert one kind of wave into the other. There are four basic transducers in audio, and they come in two complementary pairs: the microphone, which converts acoustical to electrical energy, and the loudspeaker, which converts it back; the record cutter, which converts electrical energy into mechanical wiggles in the record groove, and the phonograph pickup cartridge, which decodes these wiggles into an electrical signal again.

The microphone is, of course, the first transducer; and though not all of us may have microphones in our homes (the ones in our telephones excluded), the microphone deserves more than a passing glance.

Basically, a microphone consists of a small diaphragm, which is moved back and forth by the sound waves striking it, and some sort of device to convert these motions into a varying electrical signal, (though in some types of microphone, as we'll soon see, both diaphragm and conversion mechanism are the same).

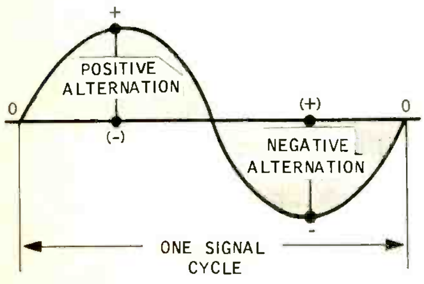

Fig. 2. Positive and negative impulses combine to form a complete cycle of the electrical signal.

As we saw a few chapters ago, sound waves consist of alternate "compressions," where the air molecules are squeezed together, and "rarefactions," where they are thinned out. In essence, we may consider the microphone diaphragm as being pushed in by the compressions, and sucked back by the rarefactions (*Fig.* 1); and the transducing mechanism converts these alternate pushes and pulls into an alternating electrical current—the signal (*Fig.* 2). Some microphones are miniature generators that convert mechanical to electrical energy; others are modulators, that act as valves controlling the passage of electricity from some external power source. Since home-type microphones are most commonly generators, we'll consider them first.

Generator Microphones

Generator microphones are basically of two types, the dynamic and the piezoelectric. Dynamic microphones, whether of the moving-coil or ribbon types, generate a voltage by moving a conductor through a magnetic field (the principle, by the way, on which most power generators work, though their construction is far different). In the case of the ribbon mike, the generating element and the diaphragm are one and the same—a thin, slightly wrinkled ribbon of aluminum measuring perhaps ⅙-in. wide by ¾-in. long, fixed at both ends and moving within the field of a permanent magnet (*Fig.* 3). In the more-common moving-coil type, the generating element is a coil of wire wrapped around a tubular form fastened to the back of the diaphragm (*Fig.* 4); the term "dynamic" is sometimes used to refer to this type of microphone alone.

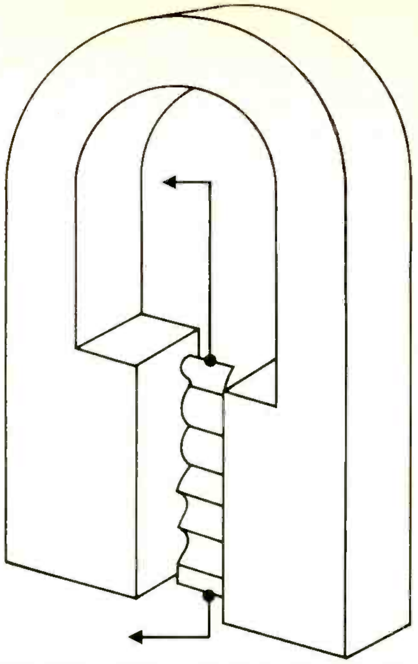

Fig. 3. The ribbon microphone. The motion of the conductive ribbon within the field of the magnet surrounding it generates a voltage across the ribbon.

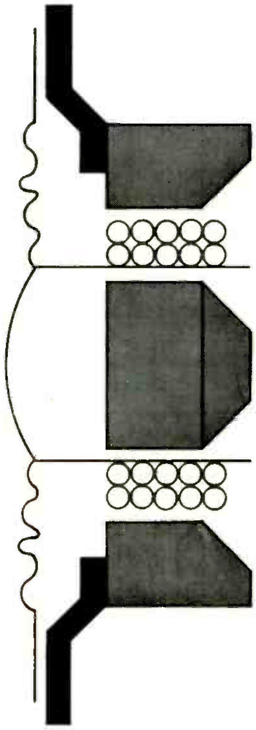

Fig. 4. The moving-coil dynamic microphone. As the diaphragm moves back and forth, the coil moves through the magnetic gap, generating a voltage.

Like most generators, dynamic microphones can act as "motors," too: when an alternating current is fed to them, they will convert it into acoustical energy. The moving-coil design is, in fact, the basis for well over 90 per cent of the loudspeakers in use today (*Fig.* 5), and the ribbon design, while more fragile, is used by at least one English manufacturer as a high-frequency speaker, or "tweeter."

But while the principles of operation are the same, speakers are far more robustly constructed; don't try using your microphones in their stead, or you may burn them out. And a speaker can be used without damage as a microphone (many intercoms use just such double-duty units), but it won't make a very good one.

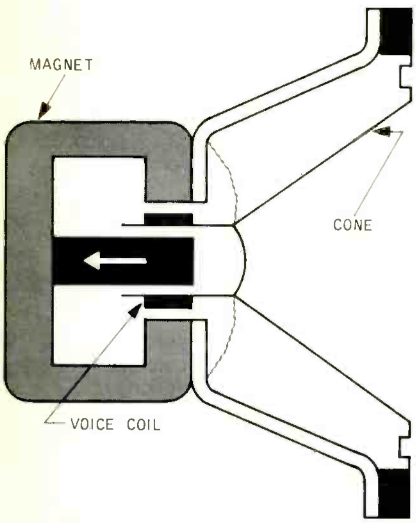

Fig. 5. A dynamic loudspeaker. The diaphragm has been elarged by the addition of a cone in order to move large quantities of air, but the construction is otherwise similar to the microphone of Fig. 4.

That's in part because transducers aren't terribly efficient. Only a small portion of the energy fed to the transducer comes out the other end in its converted form; most of the energy input is dissipated as heat. If a speaker is to reproduce the sound of a full orchestra—or even a solo piano—at a convincingly realistic level, it must be fairly massive. And since only a fraction of the power fed to the speaker (between 1 and 5 per cent, with most units) will be converted into sound, the electrical end of the speaker must be capable of handling between 20 and 100 times as much power as will come out the other end as sound —plus a safety factor in case of accidental overloads. The hefty mechanical package that results isn't easily moved by the delicate vibrations your voice imparts to the air—and however much these sound waves do move the speaker cone, only 1 to 25 per cent of that energy is converted to an electric signal in a speaker system.

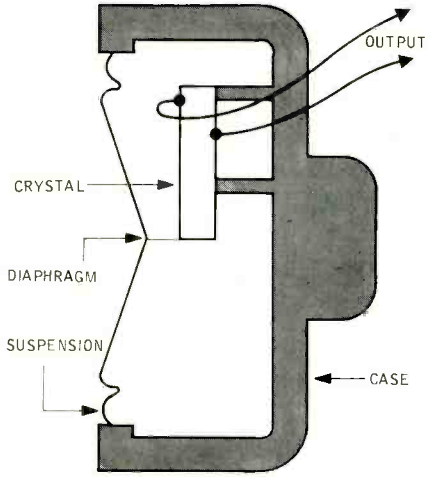

Fig. 6. A crystal microphone. A ceramic microphone would differ only in the use of a ceramic material instead of a crystal. The motion of the diaphragm bends the piezoelectric element, which generates a voltage.

Piezo-electric Microphones

Some substances, such as Rochelle salt crystals and barium titanate ceramics, twist or bend when an electrical current passes through them—and conversely, produce a voltage across their faces when twisted or bent. This property is called "piezoelectricity." Since the deformation is proportional to the voltage, and *vice versa*, piezo-electric substances are used for a wide variety of audio transducers. Hitch one to a diaphragm, and it becomes a crystal or ceramic microphone (*Fig.* 6) (or earphone, depending on its design and intended application). Connect it instead to a stylus, and it can either cut records or play them back, again depending on how it's built and used.

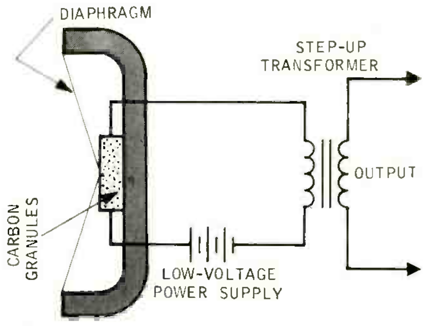

Fig. 7. The carbon microphone. Note that it requires an external power supply. The transformer passes the alternating signal, but not the d.c. from the power supply.

Modulators

You almost certainly have one form of modulator microphone in your home —the one in your telephone. This is a carbon microphone (*Fig.* 7). Its active element is a cup of carbon granules called a "button." The button is mechanically linked to the diaphragm, and electrically connected in series with some source of direct current—a battery will do. The resistance of carbon granules varies with the pressure on them. When a sound wave pushes the diaghragm in, it compresses the carbon granules, decreasing their resistance. This increases the current flow in the circuit. When the diaphragm moves out again, the pressure on the granules goes down, and so does the current flow. The resulting variations in current are fed through a transformer, (which passes the fluctuating signal but not the d.c. mixed with it) to the telephone line, an amplier, or whatever circuit it is supposed to feed.

Few audiobuffs own capacitor (or "condenser" microphones, since they are quite expensive. But recording studios use them extensively for the extreme clarity and fidelity of their sound. Most

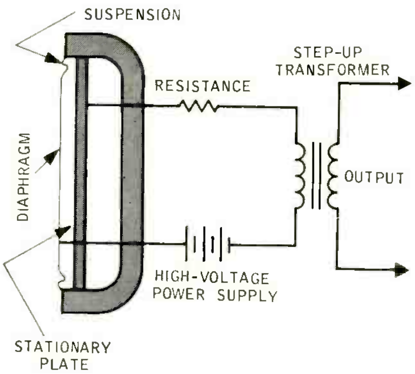

Fig. 8. The condenser microphone. Note that it, too, requires a power supply—a hallmark of "modulator" microphones.

condenser microphones, like the carbon mike, modulate a direct current; but a few modulate a radio frequency instead. The principle, in either case, is the same.

A condenser microphone consists of a flexible diaphragm a slight distance from a stationary plate (*Fig.* 8). These two plates form a capacitor, and the value of this capacitor changes as the movements of the diaphragm alter the distance between it and the stationary plate. This, in turn, makes the flow of current in the circuit fluctuate.

Now that we've had a glimpse of how sound becomes electricity, we can start in next month on the amplifiers which handle this electric signal. Æ

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Edward Tatnall Canby

"A Study in Greatness and Tragedy"

I've always been fascinated by the lives of famous inventors. No other sort of book, not even a novel, can so positively glue me to my seat and my eyes to the page for hour after hour. There isn't a mystery story in the world to match.

Last year, for instance, I absorbed a whopper, a giant book on Thomas A. Edison. Did it in a few days' leisure moments. Then came the Stephensons, father and son, who between them did the most to develop the steam loco and the railroad system in England. Great fun.

But now I've discovered a real dilly, a neglected work, at that, which I think is of absolutely first importance—right in the middle of our own field, electronics, audio, radio, hi-fi.

The book, "Man of High Fidelity," is out of print because it is twelve years old. It was written too soon. I hope it won't be out of print for much longer. It should be put into paperback quickly. For if even a volume of the sort was timely *right now*, in our area, this is it.

It came out as a tribute to its inventor-subject soon after his death. At that point, he was at a low stage of fame and troubles—hence the suicide which ended his career—and his work was in an even lower stage of enforced discredit, outrageously so, as it is easy to say today after the fact. No wonder the biography went out of print! Now, all these years later, it has been rediscovered along with the inventor himself. An exciting story.

Now who could this man be, so subject to neglect in the 1950's, now making a posthumous come-back? Let's see, (you're saying to yourself), could it be Marconi?

No—no, not the father of wireless telegraphy, who has been sitting safely in his proper historical niche for a long time. How about Hertz, then, what with all this recent fuss about Hz and all that? Nope, no hertzes. Nor any maxwells, gausses, henries. (Maxwell would make a tough biography for those who can't absorb the math in his Dynamical Theory!).

Our man is much more recent. Right now, he is at last re-emerging, thirteen years after that tragic suicide, as a major force in electronic history and one of the great original American inventive minds along with Morse, Edison, and such. What makes his biography so exciting, then, is that the boondocks are still full of people who knew him, including many of our readers—his radio associates, his old engineering cronies, colleagues, assistants, students, his lawyers and, of course, his adversaries in many a fearsome legal battle involving enormous fortunes in the radio-electronics game. There are even more of us still around who have at least in some way been personally touched by the dramatic events in this man's life, a "study in greatness and tragedy," as the book jacket puts it. That includes me, decidedly. My life is all mixed up in this book, too.

Indeed, the text of it bristles with names still familiar to almost all of us, men who are very much on the scene in these mid-sixties, some thirteen years after the great man's tragic death.

Who else could it be but *Major Edwin H. Armstrong?* Who else but the man whose early regenerative circuit in 1912, when he was still in Columbia at engineering school, finally put the vacuum tube to use in the classic ways we know so well and explained its operation both as an amplifier and as a controllable oscillator? Who but the man who in 1918 put together out of a passel of known but useless principles the standard receiver circuit that has dominated radio (and TV) ever since, the superheterodyne? Who but this same man who, as his last invention, crowned his career with that extraordinarily ingenious broadcast system, FM radio—'way back in 1933—and did not live to see its vindication? I need say no more. *Armstrong,* of course.

The Major, as he was always called, was a familiar figure for years and years around the radio clubs, the meetings of the I.R.E., assorted august court rooms and anywhere that radio gadgetry might be found. A big, burly man with a bald head and belligerent, bulldog features, he had the fighting mind of a bulldog too and did not even look like a "bright" inventor. But he was, as all who heard his forcefully clear papers (and have read them since) are aware. He saw straight through, where others could find only confusion; his theories and his factual inventions *worked*—often in the face of accumulated authority to the contrary.

He was the father of modern radio and TV broadcasting, inventor of the major circuits that made the whole enormous broadcast development possible. He is also father to our own industry, and doubly so. First via the very principle of electronic amplification, discovered in the 1912 regenerative circuit. And second via FM radio and his ceaseless work in the early FM years to develop better audio components that would match the superior quality of the FM transmission.

FM stereo is now taking its full place as the last link in the complete stereo chain of home entertainment. But it was FM which furnished the very first link, as well. FM sound quality, in those first broadcasts of the early war years, sparked the "hi fi" movement and the large component industry that has since grown up to satisfy it.

I should know. That's where I came into a small corner of this picture. Though I had owned and even built components of a sort since the mid-thirties, it took FM to show me what "high fidelity" could mean. I worked in one of the early New York FM stations, WABF, and it was there, during the war, that I first heard those wide-range sixteen-inch pressed red vinyl transcriptions at 33⅓ ips which were the forerunners of the LP record. They were played on Western Electric 9A wide-range magnetic reproducers—a revelation. But more important, I heard the same sounds *over the air,* via FM, precisely the original sounds, as though the radio transmission were entirely transparent, non-existent. Believe me (as many will remember), that was an experience in those days.

I had heard it before, in a way. I lived in a communal early-war-time "pad" in the Village along with one of the very first FM receivers—and a lad whose job was at the pioneer Armstrong FM station, W2XMN, Alpine, N. J. Mornings, he took an armful of my 78 records with him to the station. Evenings, we heard them played back via FM, along with casual comments in hi-fi. Thus did I furnish a bit of aid and comfort to the cause!

That was during the war, and though FM was already a dozen years old, very few people could not hear the little known miracle. FM, on its old band down around 40 MHz, was frozen for the Duration. Only a handful of tuners had been sold before the big clampdown—just enough to keep FM on the air, feeding on future hopes. Thus, at that time, very few people outside the profession knew anything of the man who in early radio "ham" days had been so well known—"Feedback Armstrong," they had called him then. At the full tide of his thirty years of accomplishment, Armstrong was even less known to the general public than in the years after 1912 and his first fame.

Considering its present acceptance, there was an amazing indifference—or so it seemed—towards FM, at this time when it was already long-since a perfected system, on the air. Perhaps I was naive, myself, but I do remember my own bafflement, that such a superior arrangement should not *immediately* be taken up by those who knew best—radio people.

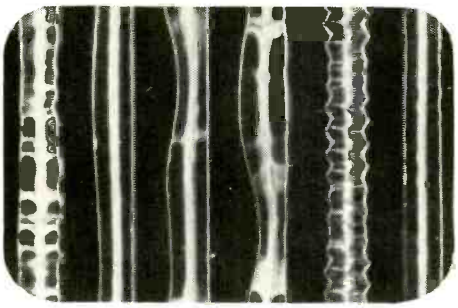
As recounted in these columns before, instead, our FM station made a brave show of expansion after the war, then collapsed. We lost our jobs because, for no visible reason, FM was a dying duck. And it was so obviously *good,* as we knew! It was a shock that I will never get over, that collapse—but imagine what it was for the Major himself, who had fought for FM already more than a dozen years?

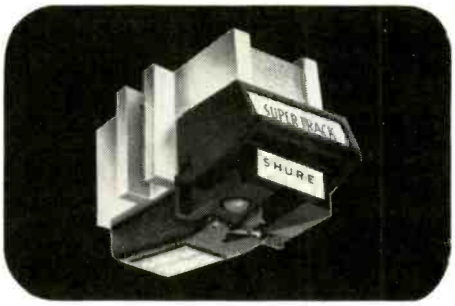
We knew it was good; yet we heard

CLOSE THE TRACKABILITY GAP

(AND YOU'LL HEAR THE DIFFERENCE)

The photomicrograph above portrays an errant, hard-to-track castanet sound in an otherwise conservatively modulated recording. The somewhat more heavily modulated grooves shown below are an exhilarating combination of flutes and maracas with a low frequency rhythm complement from a recording cut at sufficiently high velocity to deliver precise and definitive intonation, full dynamic range, and optimum signal-to-noise ratio. Neither situation is a rarity, far from it. They are the very essence of today's highest fidelity recordings. But when played with an ordinary "good" quality cartridge, the stylus invariably loses contact with these demanding grooves—the castanets sound raspy, while the flute and maracas sound fuzzy, leaden, and "torn apart." Increasing tracking weight to force the stylus to stay in the groove will literally shave off the groove walls. Only the High Trackability V-15 Type II Super-Track® cartridge will consistently and effectively track all the grooves in today's recordings at record-saving less-than-one-gram pressure . . . even with cymbals, orchestral bells, and other difficult to track instruments. It will preserve the fidelity and reduce distortion from all your records, old and new. Not so surprisingly, every independent expert and authority who tested the Super Track agrees.





SHURE V-15 TYPE II

SUPER TRACKABILITY PHONO CARTRIDGE

At $67.50, your best investment in upgrading your entire music system.

Send for a list of Difficult-to-Track records, and detailed Trackability story: Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois 60204 the denials of FM ourselves, smoothly intoned on every side. FM was visionary, impractical; it wouldn't work on a larger scale, etc. But the big argument, of course, was that people *didn't really want* FM. People didn't like "hi-fi" sound. They preferred the good old AM quality. Not too much was said about staticless reception. That argument was hard to beat, so it just didn't get mentioned very often.

Certain large corporations put an astonishing amount of effort into persuading all and sundry, including the press, that people didn't like wide-range sound. Elaborately objective tests proved it handily, with no trouble at all, and the corporations presented all this evidence in fancy demos—to their own satisfaction if not mine. It wasn't only in FM. When English Decca (later called London) brought out the first ffrr 78 shellac discs, with wide-range sound on them, I attended one of those interesting press parties where proof was abundantly offered as to the unimportance of this development. In fact, a highly respected member of the audio profession, then as today, was constrained into being master of ceremonies. It was, alas, just a part of his job, I guess.

In 1945, an FCC order dislodged FM from its band and kicked it upstairs, thereby killing off all the old receivers and most of the remaining enthusiasm for a new FM start. Strange coincidence? Were there good reasons for shifting the FM band at such a cruel moment?

That's the sort of thing you will read about—and many more situations of the same sort—in this Armstrong biography. It could have been a wholly "black and white" book, in which case it would have been far less interesting to read, for there are always arguments pro and con in such matters, and a good writing job requires a detailed look at the arguments of both sides. Burgeoning TV, the coming commercial wonder-medium as anybody could see, definitely did need air space and a lot of it. TV was on the make, and the existing radio networks were going to command the TV success within their own enormously powerful set-up. FM, small as it was, contained the seeds of an anti-network revolution.

And so it was a strange *coup de grâce* —almost—at that particular moment, but one that could in many ways be defended as "reasonable," from some viewpoints. Like, say, the network viewpoint. Yet it did hit at an obviously superior radio system at the very point where it might have begun to grow in a healthy fashion. It was nearly fatal to FM, that band change on top of everything else. Was it so intended, even by indirection?

Intended or no, I could sense the steady pressure, something negatively invisible, against FM. Bland, curiously shapeless, nevertheless it was mysteriously choking the new system right in front of our eyes and ears. A most unpleasant feeling, I can tell you. From our viewpoint there was—nothing. Just a lack of success, where there should have been success. A dead weight, not felt and yet somehow sensed, as if FM were sickening away from its own inherent inadequacy—the finest radio transmission in existence. And far in the dim background the big radio moguls of the AM networks moved in their mysterious ways, remotely ignoring our little FM world. None of *their* business! That was the way it all filtered down to us on our level.

Now, via this Armstrong biography, I know at last what was actually going on, 'way up there. And it all fits. Same for the rest of the FM battle, and for the numerous other prolonged battles that never left this man in peace. As you follow Armstrong through the mass of smoothly argued denials, interferences, obstructions, defamations, that sapped away at his extraordinary vigor and at his valuable inventions straight through his life from 1912 right up to his suicide in 1954, the drama of the whole thing becomes unendurably moving. It is a story that I think every electronic engineer should read for his own satisfaction, as well as every thinking amateur in "hi fi" and related arts—even the shortwave hams. (He was right in there, too.)

For this was perhaps the very last of the great American "solo" inventors, in the age of the corporate research lab and the high-powered team system. Armstrong was, as we now can see so poignantly, right in the line of Franklin, Morse, Henry, Edison, Bell, and perhaps as big a man as any of them in terms of the sheer force of his original contributions to his art. But this time it was one man against the huge power of the modern corporations who control our big industries. He was a terrific fighter and he fought, endlessly, for almost forty years straight. And yet he was beaten to the wall, out-argued, out-reasoned, smoothly derailed—all in the most skillful fashion—as though he were some imposter. The semantics of the legal mind and the decisions of the courts of the land and the government regulatory agencies, against plain engineering fact, flying in the face of reality (other than the reality of power interests and money), are just beyond belief in the reading. You may challenge this book if you dare. I doubt if you will.

And so I recommend *Man of High Fidelity: Edwin Howard Armstrong*, written by Lawrence Lessing (who is with *Fortune* and was once at *Scientific American*), published by J. B. Lippincott in 1956, to all who can find a copy, including engineers at R.C.A., General Electric, Zenith, Philco, Westinghouse, A.T.&.T. and associated enterprises. (I think engineers will go along with Mr. Lessing. It isn't they who make corporate decisions and put forth corporate policy.) I only wish I could write half as competently about technical matters as Lawrence Lessing does. It'll take a pretty fancy expert, I think, to find any major bloopers of a technical sort in this detailed account of the development of radio. Every page reads convincingly.

Perhaps by now someone will have taken up the paper book rights to this work. Then, maybe come fall, you can get the book again. Meanwhile, space having given out, I'll have a few more Armstrong comments next month. Æ

This Sony has ESP*

Model 660 Solid State

The world's first fully automatic tape reversing system

*Electronic Sensory Perception—an amazing Sony development. The ESP electronic brain constantly scans and automatically senses the voice or music modulations on your recorded tapes. Within 10 seconds after the sound has ended, the Electronic Sensory Perceptor *automatically reverses the tape direction!* Then, magically, the music resumes—every note flawlessly reproduced. You never touch the tape, you never touch the recorder – Sony ESP reverses the tape automatically. You never again bother about recording electronic reversing signals. Sony ESP tape reverse is activated solely by silence. Sony ESP automatic tape reverse works on your old tapes and on your new tapes. The Sony 660 also records in both directions for making your own 4-track tapes.

And the Sony 660 adds a whole lot more. XL-4 Quadradial Speaker System surrounds you with a virtual curtain of stereophonic sound. 50 watts of pure music power per channel. Two professional V U meters. 3 motors. 2 speeds. Sound on sound. Separate bass and treble controls. FM stereo inputs. Push-button solenoid activation of all mechanical modes. For literature and address of dealer nearest you, write Superscope, Inc., Department 17, Sun Valley, California.

AMERICA'S FIRST CHOICE IN TAPE RECORDERS

SONY® SUPERSCOPE® The Tapeway to Stereo®

SONY'S PROOF OF QUALITY — A FULL ONE YEAR WARRANTY

Check No. 108 on Reader Service Card.

New Audio Books

Troubleshooting Audio Equipment by Mannie Horowitz. Soft cover, 160 pages. Published by Howard W. Sams & Co., $3.25.

Though directed to servicemen or audio buffs who can roll their own, this book should also appeal to many hi-fi enthusiasts who enjoy some limited knowledge of electronics. Judging from the book's title, it might seem to emulate the author's earlier book, "Troubleshooting High Fidelity Amplifiers," published by AUDIO Magazine It doesn't, though there are fleeting similarities. The new, original book emphasizes hi-fi transistor circuits (though vacuum tube circuits are not altogether neglected), whereas his earlier book devoted only one page to transistors.

Horowitz lays the groundwork for the remainder of the book in his initial chapters, discussing components that make up a hi-fi system and basic electronic theory. This is followed by an examination of triode amplifiers, starting with tubed circuits and how they work. Then the whys and wherefores of locating defects are discussed. After this, transistor circuits, the solid-state counterpart of triode tube circuits, are examined from the same vantage points. The following chapter covers power supplies. Troubleshooting, functions, variations, and defects in that order. This is a rather disjointed editorial approach, as you may imagine. Troubleshooting and defects sections somehow find themselves at the beginning and at the end of the chapter respectively.

There are other signs of poor organization. Chapter 5 covers test equipment and results, with a pause until Chapter 12 for additional test equipment and a brief description of uses. In between are chapters on output circuits, phase inverters and drivers which precede the output stage, and on troubleshooting power amplifiers. The latter material rightly belongs with output circuits which also details troubleshooting procedures. Vacuum tube and transistor tone control circuits, preamplifier and equalization circuits, preamplifier hum, troubleshooting tape recorders, and stereophonic systems round out the remainder of the book.

The how-it-works-and-why-it-may-not approach is used throughout to the benefit of the reader. Transistor circuits are explored which, somehow, have been largely ignored by other authors who still dally with tubed circuits. This is much to the author's credit. The Howard Sams staff maintains their usual high standard of drawing and schematic clarity in this profusely illustrated book. On the debit side, too many chapters lack depth. We're especially thinking of the chapters on tape recorders and stereo systems. But, then, in fairness to all, enlarging the book would have increased the price.

We recommend the book to readers who aren't thrown by technical information which isn't spoon-fed. Reading it over a few times will probably jostle you into thinking in terms of transistors.

Letters from Readers

Record Player Compendium Correction

SIR:

There were inaccuracies in the Miracord listing in your March issue's record playing equipment section. You showed the arm type of the Miracord PW-40A and the PW-40H as being unbalanced. The arm system used for this model is of the "dynamically" balanced type. I note also that you left off the dimensions of the Miracord PW-50H.

Benjamin Electronic Sound Corp.
JOSEPH N. BENJAMIN
Farmingdale, N. Y.

Sorry. The Miracord 40 Series does *incorporate a tone arm that is "dynamically" balanced; that is, an adjustable counterweight at the rear of the arm balances it, and adjustable spring-torque tension at its vertical pivot provides stylus force required. Chassis-plate dimensions of the PW-50 are 14½" wide × 12½" deep*—ED.

Would The Real Manufacturer Stand Up?

SIR:

Would you please identify the turntable on the cover of the September 1966 issue of AUDIO. Also, what is the receiver?

E. L. JONES, JR.
Atlanta, Ga.

The "components" are Institute of High Fidelity (IHF) mockups. They are composite designs of existing hi-fi components, generally utilized by the IHF to demonstrate how nicely hi-fi gear can fit into different room decorating schemes—ED.

Likes Video Test Pattern

SIR:

Could you direct us to the Electronic Industries Association. We would like to obtain a copy of the test pattern shown in the March 1967 issue.

F. E. BATT
Trail, B.C., Canada

Contact the Electronic Industries Association (EIA), 2001 Eye St., N.W., Washington, D. C. 20006—ED.

Who Makes Field-Effect-Transistors?

SIR:

I have read William A. Rheinfelder's article on High Fidelity Phono Preamp with FET's. Would you provide me with the names of FET manufacturers who can supply this semiconductor device so that I can contact them?

BIHARI R. PATEL
Bombay, India

The directory below lists manufacturers of junction field-effect-transistors, the type described in author Rheinfelder's article, as well as insulated gate (MOS) field-effect-transistors.—ED.

Amelco Semiconductor, 1300 Terra Bella Ave., Mountain View, Calif. 94042.
Crystalonics, Inc., 147 Sherman St., Cambridge, Mass. 02140.
Fairchild Semiconductor, 313 Fairchild Drive, Mountain View, Calif. 94040.
General Instrument Corp., 600 W. John St., Hicksville, N. Y. 11802.
Motorola Semiconductor, 5005 E. McDowell Rd., Phoenix, Ariz. 85008.
Radio Corp. of America, 415 S. Fifth St., Harrison, N. J. 07029.
Siliconix, Inc., 1140 W. Evelyn Ave., Sunnydale, Calif. 94086.
Texas Instruments, Inc., P.O. Box 5012, Dallas, Texas 75222.

Reprint Availability

SIR:

In 1964 you ran a series of articles, "A Basic Course in Commercial Sound," and you are currently running a series, "Audio Measurements Course," both authored by Norman H. Crowhurst. Are reprints of these series available in a complete package and, if so, what is the cost?

Sylvania Electric Products, Inc.
DONALD PARTIS
Batavia, N. Y.

Neither series has been published as a complete package. However, AUDIO *can supply copies of the articles for a nominal cost (50¢ per article)*—ED.

Two Altec Flamenco speakers are perfect stereo. They belong together. But, when a Man with a Golden Ear has a wife with an eye for decor, something must come between them. Not between the man and his wife. Between the speakers. Altec now provides a matching, hand-crafted equipment cabinet which, all together now, results in perfect sound and perfect styling . . . the Flamenco Ensemble.

The speakers first. Each 848A Flamenco speaker contains the exact components of the famous Altec A7 "Voice of the Theatre"® speaker system. Each gives you the perfect sound one can expect only from professional equipment. Between all this sound, is the ultra-convenient equipment cabinet to house your receiver, changer and tape deck, with plenty of room for tape and record storage.

The look . . . that's something else again. Ageless oak is reminiscent of the Andalusian plains accented with simulated wrought iron that recalls the castles of Castile. To complete your system the Flamenco ensemble deserves nothing less than the 100-watt Altec 711A, the world's first all-silicon transistor receiver.

Now you really have something. Prices? The Flamenco speaker system is $345 each. The oak equipment cabinet is $359. The 711A receiver, $399.50. Write for complete information and the name of your nearest dealer. And be happier ever after.

A Division of LTV Ling Altec, Inc.
Anaheim, Calif. 92803

ALTEC LANSING

EDITOR'S REVIEW

HELLO, AUDIO READERS

YOU'LL OBSERVE A NEW NAME on the masthead of AUDIO Magazine—Arthur P. Salsberg, as Editor. C. G. McProud, "MAC" to AUDIO readers he served in this capacity for almost 20 years, will now devote full energy to his many responsibilities as Publisher.

Inevitably, a "Changing of the Guard" produces modifications after a settling-in period has passed. No doubt this will hold true here, too. But not change for the sake of change. How we can best serve you, the reader, is our uppermost consideration. So why not tell us what you like, what you don't like, and about subjects you wish to appear in future issues of AUDIO Magazine? Use the convenient, postage-paid "Hot Line" card at the back of the magazine, following page 66. Thanks.

VIDEO TAPE FANFARE CONTINUES

General David Sarnoff of RCA says that the home video tape recorder may be the next major consumer product equal to color television receivers. And with the great success of home radio and color television receivers backing up his earlier predictions, we know he's not an idle prognosticator.

No one expects HVTRs to be *mass* marketed by any stretch of the term until prices drop from present costs to more comfortable three-figure ones. Equally as important as selling price, this will have to be accomplished by respected manufacturers who enjoy good distribution channels. We look to Ampex, Concord, Norelco, Panasonic, and Sony, among others, to effect this. Some of these companies have already made notable inroads in the consumer market.

We just received an interesting package in the mail that relates to HVTRs. It contained a ¼″ strip of video tape recorded with 16 full channels of color TV, information which was taped off-the-air. (Eight-track tape cartridges move over.) But that wasn't all—a 2″ diameter spool of ¼″ tape, called a "reelette," contained a complete LP sound album. Playing time of the tape, which was duplicated and distributed by General Recorded Tape of Sunnyvale, Calif., is said to be 44 minutes. Ostensibly, the tape would be used in conjunction with a video tape recorder that incorporates a great number of separate tracks. We would hope that video information was included that parallels the results achieved by some jukebox manufacturers in France who combine sight and sound with their equipment. With the "reelette's" title, *Music To Watch Girls By*, it would be a shame if this were not so.

COMPONENT HI-FI ROOM DECOR EXHIBIT LAUNCHED

The National Design Center in New York City, in combination with the Institute of High Fidelity, recently unveiled to the public five decorator rooms graced with component high fidelity equipment. The IHF room settings include a contemporary living room, contemporary recreation room, modern den, modern bedroom, and modern one-room apartment. Components are imaginatively placed to complement room decor—in sliding cabinet drawers, flush-panel faceplates, on shelves, etc. This should go far in illustrating to Doubting Thomases that the location flexibility of components offers distinct advantages over "package" equipment. True, it calls for a bit more effort. But, judging by the tasteful blending of components into rooms at the exhibit, the results can be well worth it. The five separate exhibits will give way to a single-room setting November 1967. This decorator room will be included in NDC's "Ten Best Dressed Rooms of the Year" exhibit. A single-room setting which combines components has been exhibited at NDC's Chicago location since January. Good Show, IHF!

TWO INDUSTRY EXECUTIVES

As we go to press, we learned of the tragic death of J. Richard Bucci, 31, McIntosh advertising manager, his wife Barbara, and Mrs. David Campbell of Vestal, N. Y., wife of McIntosh's chief engineer. The two women were passengers in a light private plane piloted by Bucci when it was hit by another plane during a routine landing at New York's LaGuardia Airport on the evening of May 1. The Bucci's are survived by two daughters—Noel, 10, and Megan, 8. Since joining McIntosh Laboratory in January, 1964, Dick had become one of the best liked members of the industry, and a great future was expected for him.

On the same day, Morris Zigman, president of Morhan National Sales Co., New York, was the victim of a heart attack in London, at the age of 62. Morhan was originally solely an exporting firm, but recently became national distributor of Irish Tape, in addition to its export activities.

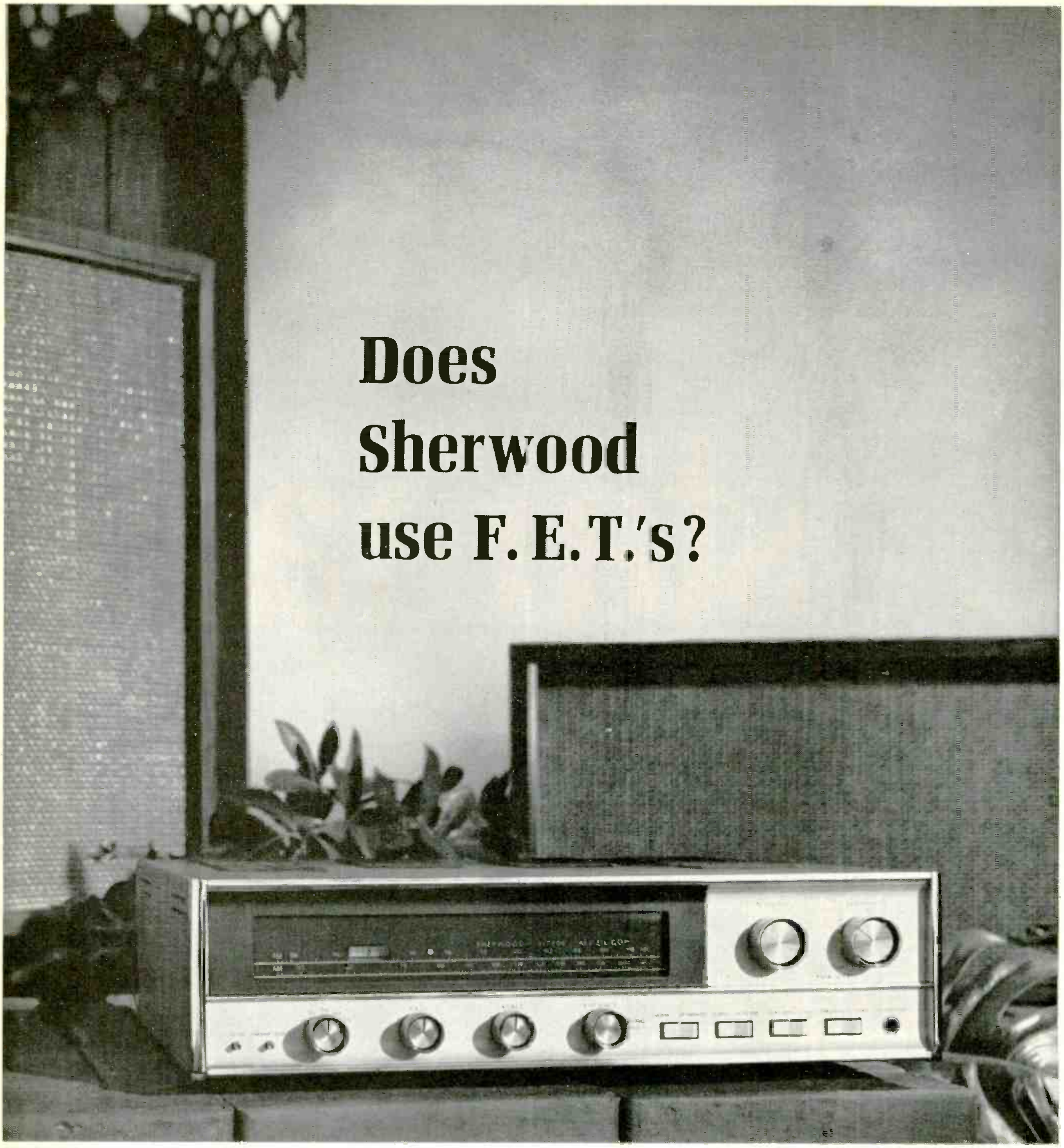
Dustamatic:

the cartridge that cleans the grooves while it plays.

The new Pickering V-15/3 Micro-Magnetic™ stereo cartridge proves that cleaner grooves combined with cleaner tracing result in cleaner sound. The built-in Dustamatic™ brush assembly automatically sweeps dust particles from the groove before the stylus gets there; and the new moving system reduces tracing distortion close to the theoretical minimum, thanks to Dynamic Coupling of the stylus tip to the groove. There are four "application engineered" Pickering V-15/3 Dustamatic models to match every possible installation, from conventional record changers to ultrasophisticated low-mass transcription arms. Prices from $29.95 to $44.95. For free literature complete with all details, write to Pickering & Co., Plainview, L.I., New York.

For those who can hear the difference. **Pickering**

COMPARE THESE NEW SHERWOOD S-7800 FET FEATURES AND SPECS! *ALL-SILICON* RELIABILITY. INSTAMATIC OUTPUT OVERLOAD PROTECTION CIRCUITRY. NOISE-THRESHOLD-GATED AUTOMATIC FM STEREO/MONO SWITCHING. FM STEREO LIGHT. ZERO-CENTER TUNING METER. FRONT-PANEL FM INTERCHANNEL HUSH ADJUSTMENT. MONO/STEREO SWITCH AND STEREO HEADPHONE JACK. ROCKER-ACTION SWITCHES FOR TAPE MONITOR, NOISE-FILTER, MAIN AND REMOTE SPEAKERS DISCONNECT. MUSIC POWER 140 WATTS (4 OHMS) @ 0.6% HARM DISTORTION. IM DISTORTION 0.1% @ 10 WATTS OR LESS. POWER BANDWIDTH 12-35,000 CPS. PHONO SENS. 1.8 MV. HUM AND NOISE (PHONO) −70 DB. FM SENS. (IHF) 1.8 μV FOR 30 DB QUIETING. FM SIGNAL-TO-NOISE: 70 DB. FM CAPTURE RATIO: 2.4 DB. FM CROSS-MODULATION REJECTION—95DB. DRIFT ±.01%. AM SENS. 2.0 μV. AM BANDWIDTH 7.5 KC. 45 SILICON TRANSISTORS PLUS 16 SILICON DIODES AND RECTIFIERS. SIZE: 16½ X 14 IN. DP.



Did you think because Sherwood makes such beautiful receivers we would neglect Field-Effect-Transistor circuitry? The new Sherwood *ALL-SILICON* Model S-7800-FET FM/AM 140-Watt Receiver shown above has been specially designed for urban strong-signal locations.* This *ALL-SILICON* receiver offers unexcelled FM reception in areas where powerful local stations can interfere with the reception of distant and weaker stations. The Model S-7800-FET also features two separate front-panel rocker switches for multiple speaker installations throughout your home. Write for a complimentary copy of the new Multiple-Speaker Installation manual.

*Specially-selected Field-Effect Transistors in RF and Mixer stages of S-7800-FET improve cross-modulation rejection almost 10 times (20 db)

S-7800-FET 140-watt FM-AM *ALL-SILICON* Receiver
$409.50 for custom mounting
$418.50 in walnut leatherette case
$437.50 in hand-rubbed walnut cabinet

SHERWOOD 1st IN ALL-SILICON TUNERS AND AMPLIFIERS

Sherwood

Sherwood Electronic Laboratories, Inc., 4300 North California Avenue, Chicago, Illinois 60618. Write Dept. 6A

Check No. 111 on Reader Service Card.

Musical Broadcasting in the 19th Century

ELLIOTT SIVOWITCH

So you think broadcasting and "commercials" are a product of the 20th Century? Don't you believe it. There is practically nothing new under the sun, as this history from the Archives of the Smithsonian Institution shows.

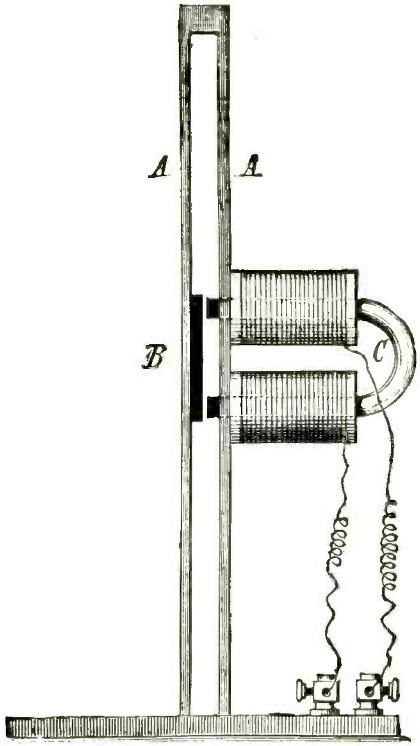


Fig. 1. Farrar electromagnetic receiver, 1851.

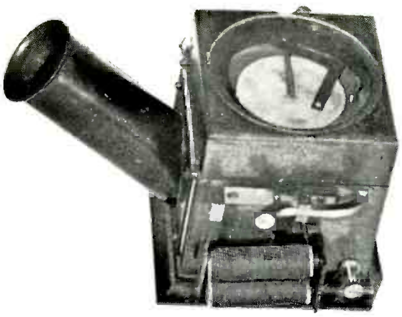


Fig. 2. Reis telephone transmitter, 1860.

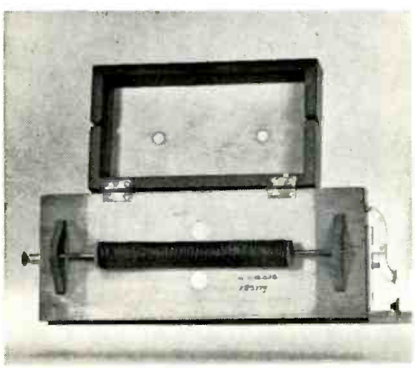


Fig. 3. Reis telephone receiver, also 1860.

When Lee de Forest broadcast the opera *Cavelleria Rusticana* from the stage of the Metropolitan Opera House in New York on January 13, 1910, he was quite certain that he was the first to have anything of this kind. And in the sense of "wireless" broadcasting of opera he was probably correct. The technical arrangement on the stage included an "Acousticon" carbon microphone with a battery in circuit and a connecting wire link to a telephone receiver in the transmitter control room. The receiver was taped to the microphone of de Forest's arc transmitter. A duplicate Acousticon stage microphone was located on a small table before which the tenor Ricardo Martin stood when he sang the opening aria *La Siciliana*. Before the curtains were withdrawn for the opening scene this table microphone and accessories were quickly removed from sight. All the musical activities were also broadcast over a wire line to the offices of the New York World, where Kelly Turner, president of the National Dictograph Company[1] demonstrated reception before a small audience of reporters.

Although the wireless aspects of the broadcast may have been novel, the wire line transmission certainly was "old hat" as far as telephone engineers were concerned. As early as June 18, 1878, Donizetti's comic opera *Don Pasquale* was sent over wire line to a small group of listeners at Bellinzona, Switzerland, and certainly no one can say that this was the earliest musical broadcast—the transmission of music by telephonic means is indeed as old as the art itself. But since we have to begin our story at some point in history, perhaps we can commence in 1851 with the experiments of Edward Farrar of Keene, New Hampshire. Farrar, mayor of that city, spent his leisure moments experimenting with a musical telegraph. He is supposed to have had some correspondence with Professor Silliman of Yale University relative to certain problems in transmission. His "transmitter" was a reed melodeon capable of sending musical tones over a wire telegraph line. His receiver, *Fig.* 1, was every bit of an electromagnetic loudspeaker.

Although Farrar was apparently discouraged by Professor Silliman from further investigations into the speech capabilities of these instruments, it was not long before Philip Reis of Freidrichsdorf, Germany, was engaged along similar pursuits. Reis, around 1860, devised a method of sending musical tones over a set of instruments, the transmitter of which was to become the focal point of an argument among early telephone experts. The substance of this discussion was whether the device (*Fig.* 2) operated by the interrupted contact or variable resistance principle. Although the receiver, *Fig.* 3, took a "back seat" in many of these debates, it is of some importance, at least, to mention this instrument which some refer to as a magnetostriction telephone or loudspeaker. The unit is basically a form of electromagnet with extended pole pieces affixed to a wooden sounding box. Although this author favors the belief that the Reis receiver operates by simple induction, the experimental fact is that the unit has speech capability when used with a good-quality carbon transmitter.

[1]Manufacturers of "Acousticon" hearing aid equipment.

Using the term "broadcasting" in the general sense of conveying both music and speech electrically to distant locations, it can be shown that the transmission of programs for entertainment and educational purposes was an integral though little known part of the development in telephone technology during the final three decades of the last century. During this period, electroacoustical instruments were developed that had performance characteristics or possibilities far beyond that envisioned by their inventors. It remained for 20th Century innovations, especially in the field of signal amplification, before the true potential of these devices could be realized.

The artifacts illustrated are in the collections of the Smithsonian Institution. The author is Assistant to the Curator in the Division of Electricity of the Museum of History and Technology.

The material presented here was originally given as a lecture-demonstration before the Annual Meeting of the Antique Wireless Association in Philadelphia, September 25th, 1966.

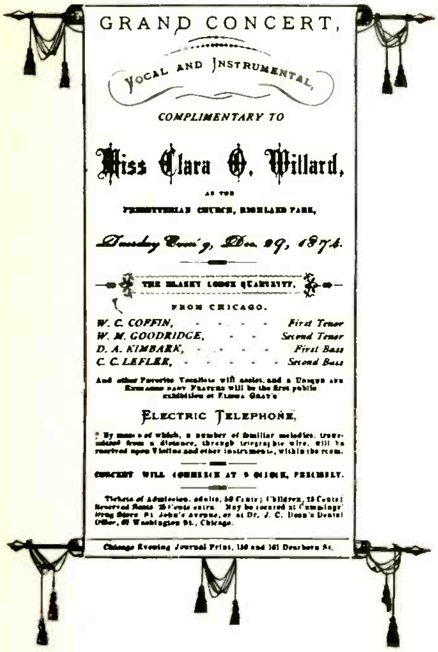
The author

All illustrations through courtesy of the Smithsonian Institution.

Tone Telegraphy

The next step in the development of so called musical or tone telegraphy may be described in the experiments of Elisha Gray of Chicago (1835-1901), co-founder of the firm of Gray & Barton, later known as the Western Electric Company.[2] Gray had taken out a number of patents relating to the transmission of musical tones via telegraph. This development was three fold: First in the direction of multiplex transmission for telegraphy, then in the direction of musical performances for public entertainment, and finally towards a speaking telephone. In the mid-1870's Gray, on several occasions, demonstrated his instruments before audiences (See *Fig.* 4). The transmitters that he used were basically electromagnets that actuated tuned reeds, thereby interrupting the flow of current in the circuit at the reed frequency. One of these instruments, *Fig.* 5, was capable of a two-octave diatonic scale arrangement. For receiving purposes an electromagnetic transducer was employed. A typical device is the one illustrated in *Fig.* 6 which may be termed a "hornless magnetic speaker." Constructed in 1874, it is simply a dual electromagnet with a "dishpan" diaphragm. Later, during the Bell-Gray litigation over the telephone, the "dishpan" receiver was shown to have speech capability. It is interesting to observe that both the Reis and Gray receiving instruments perform adequately as transmitters when used with the low-level input of a modern tape recorder.

[2]After Western Electric's non-telephone activities were divorced from WE, the new company was called "Graybar" from the names of the original founders.



GRAND CONCERT,

VOCAL AND INSTRUMENTAL,

COMPLIMENTARY TO

Miss Clara O. Willard,

Tuesday Even'g, Dec. 29, 1874.

FROM CHICAGO.

W. C. COFFIN, - - - - - First Tenor
W. M. GOODRIDGE, - - - Second Tenor
D. A. KIMBARK, - - - - - First Bass
C. C. LEFLER, - - - - - - Second Bass

ELECTRIC TELEPHONE,

THE STEINWAY HALL PROGRAMME.

TELEPHONE CONCERTS.

TRANSMISSION OF MUSIC BY TELEGRAPH.

TRIUMPH OF AMERICAN SCIENCE.

Mr. MAURICE STRAKOSCH has the honor of announcing that the first public performance on Professor ELISHA GRAY'S marvellous

TELEPHONE

will take place on MONDAY EVENING, April 2d. Musical Melodies will be performed in Philadelphia and distinctly heard by the audience in New York.

1. "HOME, SWEET HOME."
2. "COME GENTIL," (Don Pasquale).
3. "THEN YOU'LL REMEMBER ME," (Bohemian Girl).
4. "LAST ROSE OF SUMMER."
5. "M'APPARI," romance (Martha).
6. "THE CARNEVAL OF VENICE."

Conductors: Mr. MAX LIEBLING and Mr. W. F. WILLIAMS.

Mr. STRAKOSCH is happy to announce that Professor ELISHA GRAY will be present and superintend personally the performance of the TELEPHONE.

ADMISSION, ... ONE DOLLAR.
RESERVED SEAT, . . . ONE DOLLAR AND A HALF.

Fig. 4. Announcements of "Telephone Concerts" by Elisha Gray.

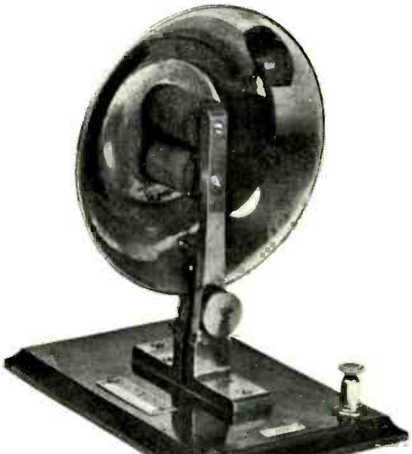


Fig. 6. Gray magneto telephone receiver, 1874.

Fig. 7. "Triple" mouthpiece used by Bell in conjunction with a magneto telephone to transmit vocal music over telegraph wires between Paris and Brantford, Ontario, during the summer of 1876.

Fig. 5. Gray keyboard transmitter, 1874.

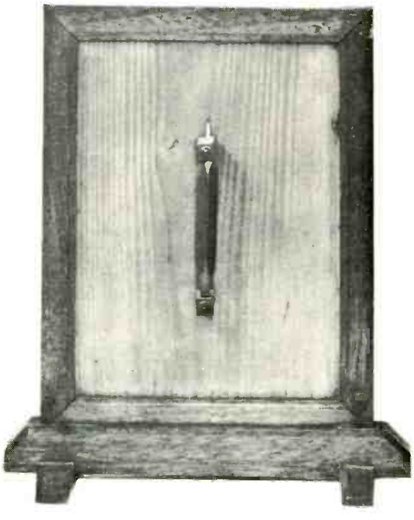


Fig. 8. Hughes carbon microphone transmitter of the type used in the operatic broadcast in Bellinzona in 1878.

Broadcasting in 1876

Alexander Graham Bell followed a similar progression of steps in multiple-tone telegraphy but then began a more systematic transition to the study of vibrating reeds and membranes, finally culminating in a successful speaking telephone. As early as the summer of 1876 Bell was transmitting vocal music experimentally over Canadian telegraph wires (See *Fig.* 7), and over the next year made several successful demonstrations of musical broadcasts to considerable distances. However, in the case of Bell these transmissions were always direct telephone pick-ups as opposed to Gray's earlier method of sending reed or buzzer tones to a telephone receiver.

For the most part, in this discussion, we are concerned with "land line" telephonic broadcasting. However, the first inkling of other transmission possibilities began to develop with the observation of conduction and induction leakages along adjacent wire circuits. This was an integral part of the development in telegraphy where elimination of the ground-wire return by Steinheil in 1838 had created an interesting condition for experimentation. Similar observations relative to induction were made in early telephony. In August, 1877, a concert was transmitted from the Western Union Building in downtown Manhattan to an audience in Saratoga Springs, New York, using the Edison telephone transmitter. The music was heard in both Providence and Boston due to induction-conduction leakages to the New York-Boston line along a 16-mile section where the two lines ran parallel to each other. It was not long after this before both induction and conduction telephony were the subject of considerable investigation.

However, so far as our main story is concerned, broadcasting as we would describe it today was confined to land-line links with special listening rooms, or to homes on a subscription basis. In order to achieve any sort of success in this area, it was necessary to develop a pick-up microphone of sufficient sensitivity. This was forthcoming shortly after the magneto telephone in the form of the carbon microphone invented and perfected by a variety of personalities including Edison, Berliner, Hughes, Gower, and Ader. It is the Hughes type, *Fig.* 8, that was installed by the Swiss telegraph engineer Patocchi at the performance of "Don Pasquale" in Bellinzona. One microphone

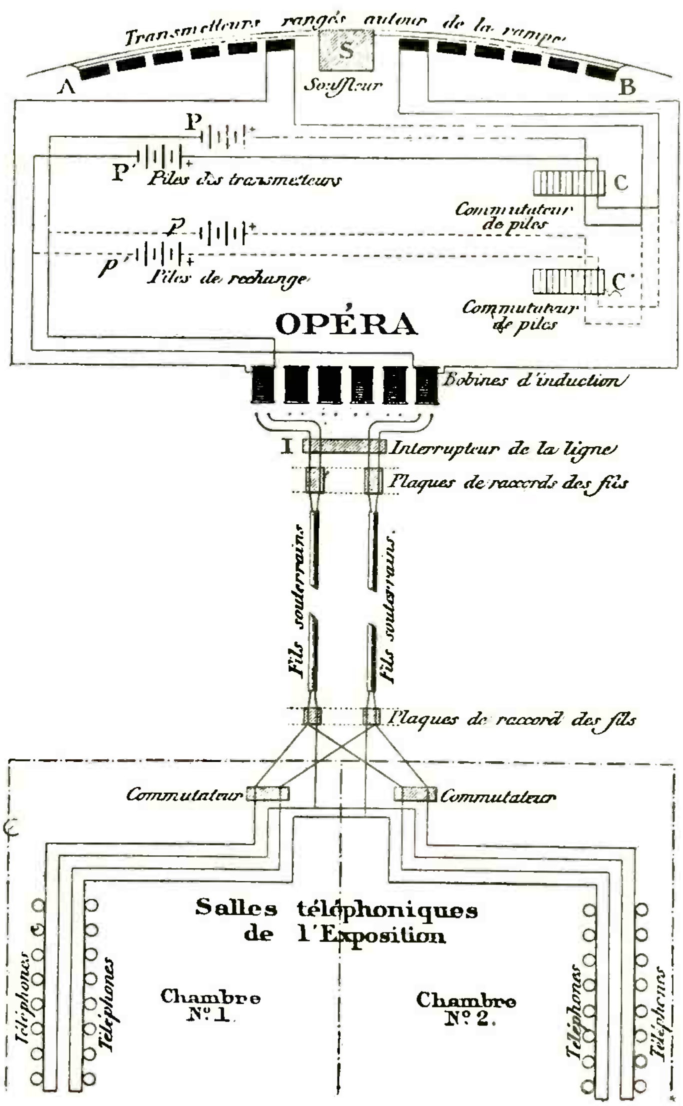


Fig. 10. Diagram of stereophonic stage and listening-room installation designed by Clement Ader in 1881 to "Broadcast" performances of the Paris opera.

Fig. 9. Clement Ader (1840-1925).

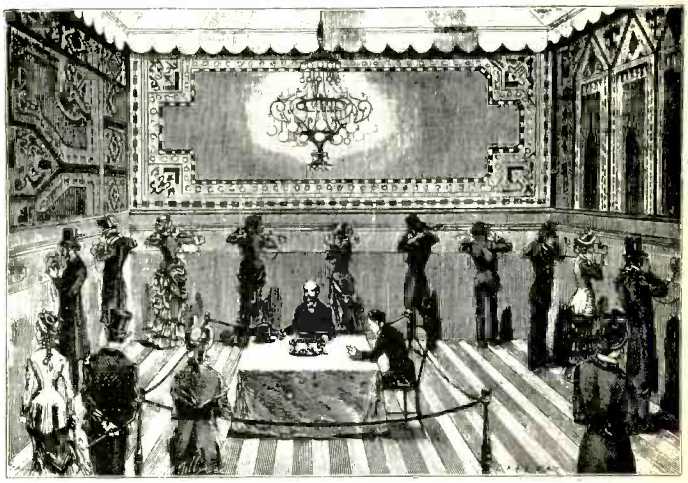


Fig. 11. Telephone listening room at the Electrical Exposition in Paris, 1881.

was placed in the first tier close to the stage and two wires conveyed upstairs to a room in the theatre where four Bell receivers had been installed. Listeners marvelled at the "quality" of the vocal sound and the "purity" and "distinctness" of instrumental music! However, it is to Mr. Ader, *Fig. 9*, that we are indebted for the significant accomplishment of sterophonic broadcasting at the Paris Opera in 1881.

First Stereo Transmission

Clement Ader (1840-1925) worked for the French Government as a railroad engineer, but resigned in 1876 to devote his full attention to the telephone. At the same time he became interested in aeronautics and spent his later years working in this new industry under several military appropriations. His telephone installation at the Paris Opera consisted of five microphones arranged on either side of the stage-prompter's box, as in *Fig.* 10, each unit having its own induction coil. One microphone on either side of the prompter's box was "matched" —so that there were five "matched" pairs, each feeding into paralleled sets of magneto telephone receivers, thus providing the stereophonic effect.

Transmission lines were fed underground two kilometers to the Palais de l'Industrie where several listening rooms were provided, illuminated by Swan incandescent lamps. In the illustration, *Fig.* 11, each listener is equipped with a set of "stereo" telephones. Stage microphones used an Ader variation of the Hughes carbon-pencil transmitter. Each unit consisted of two sets of five carbon rods arranged horizontally between carbon blocks and mounted on a lead base with rubber feet to reduce vibration pick-up (See *Fig.* 12). A thin sheet of pine wood served as the diaphragm for each microphone. Two batteries of the Leclanche type were used with each microphone, but due to rapid polarization a special commutator was devised to switch new batteries into the circuit every 15 minutes.

Contemporary accounts speak of being able to localize the singer's position on stage by virtue of the signal strength in either right or left telephone. Reception was described as a "curious" phenomenon, approximating the theory of "binauricular audition."

The Paris installation was constructed at a cost of 160,000 francs. A similar demonstration was undertaken by the Private Telegraph Company of Vienna at the 1883 Exposition in that city. In this instance the Royal Opera House was connected to the Rotunda of the Exhibition Building through an almost identical stereophonic arrangement.

The science of electroacoustics in the 19th Century was, of course, limited by the lack of amplification of signal. Many ingenious schemes were tried to overcome this handicap, all with indifferent success, but, in the search for better telephones and telephonic loudspeakers, devices appeared that bore striking resemblances, at least electrically speaking, to instruments developed in later years. One of these was the electrodynamic telephone, *Fig.* 13, invented by Amos Emerson Dolbear in 1877. Although not really designed to amplify sound, its construction with a "moving-coil" attached to a paper or cardboard diaphragm, is a 50-year predecessor of the modern dynamic loudspeaker.

Despite innovations by Dolbear, Lodge, Siemens, and others in the area of electroacoustic transduction, the telephone as a loudspeaker suffered not only by lack of sufficient power but, of course, by limitations in the fidelity of reproduction. This was true regardless of the type of microphone or receiver employed. However, experimentation toward a workable land-line broadcasting system continued sporadically after Ader's demonstration and the literature contains numerous descriptions of "telephone concerts" transmitted in the last two decades of the 19th Century.

By the mid-1890's fully commercial systems were a reality. Of particular interest was the broadcasting station at Budapest, Hungary which began operation in 1893 and was a true radio station in every sense of the word except that of having call letters and using Hertzian waves. This station, called the Telefon-Hirmondo or "telephonic news teller" was started by Theodore Buschgasch, an Hungarian engineer, with a capitalization of 600,000 florins ($250,000) from a private stock company. The studios occupied two stories of a building on one of Budapest's main avenues.

"Commercials" in 1909

Including the technical staff, 180 people were employed by the station. The company had the same rights as telephone and telegraph interests in being permitted to string wires throughout the city. 560 kilometers (approx. 350 mi.) of wire were in service by 1909 throughout a total of 27 districts in the city. Microphone transmitters in the Opera House were connected to the control office via wire line. An amplifying system, presumably of the carbon-repeater type, was employed before signals were fed to the distributing system. Each of the "Hirmondo's" 6200 subscribers had a double telephone magneto receiver (non-stereo).

Operating expenses were 9-10,000 florins per month—subscribers paid 18 florins per annum for the service (a florin was 42c). Advertisements were permitted at the rate of 1 florin for 12 seconds. Regular telephone rates were 150 florins per annum.

The operating staff consisted of six news announcers called stentors (See *Fig.* 14), a business manager, and several editorial assistants. In addition a number of singers were employed for the broadcasting of concerts, as in *Fig.* 15.

In the early years the station was "on the air" from 7:30 a.m. to 9:30 p.m. This was later changed to a 12-hour period between 10:30 a.m. and 10:30 p.m. A full published program was available to subscribers—typical programming included stock exchange reports in the morning from 10:00-10:30, 11:00-11:15 and 11:30-11:45. Special news resumes were broadcast

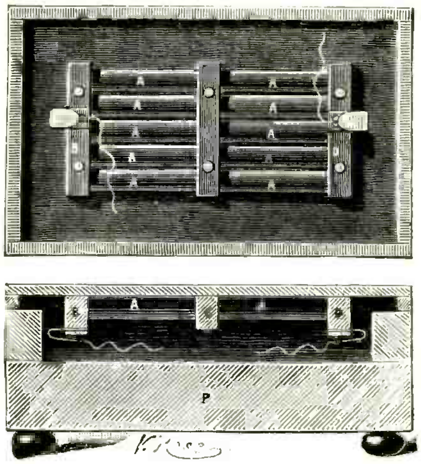


Fig. 12. Ader carbon transmitter employed for stage microphone pick-up of vocalists and orchestra at the Paris Opera House.

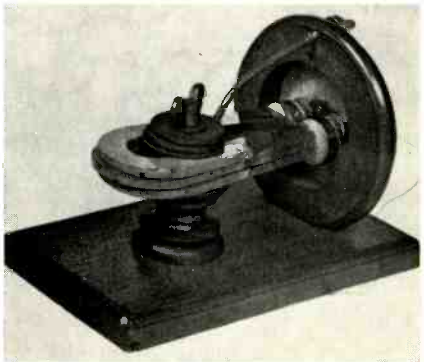


Fig. 13. Dolbear Electrodynamic Telephone, 1878. (note relative size of the "voice coils,")

at 1:30 and 6 p.m., with concerts scheduled from 5:00 to 6:00, varied with literature criticism, sporting events, and so on. Special items for Sunday included a newscast from 11-11:30 a.m. and a concert from 4:30-6:00 p.m. A children's concert was scheduled each Thursday at 6 p.m. Subscribers were generally alerted to news broadcasts by a special ringing alarm attached to the receiving equipment.

Thomas Denison, the American journalist who studied the station's operation, reported that the "stentor" broadcasts were well received by the public, but that the "telephone timbre" of musical transmissions left much to be desired. Electrical storms would also interfere with the lines.

London Broadcasts—1892

A similar though less-expensive operation began service in London during the same period. Following the successful transmission of music from the Lyric Theatre in London to a listening room in the Crystal Palace Electrical Exposition over an experimental six-month period in 1892, the Electrophone Company was formed for the purpose of broadcasting music and speeches to subscribers. This organization worked under an agreement with the National Telephone Company. As opposed to the Telefon-Hirmondo of Budapest, the "electrophones" were connected by special switches on the subscribers' standard equipment. This service formally started in London in 1895. At the end of one year there were 47 subscribers, but after 12 years of operation over 600 subscribers were enlisted and some 30 theatres and churches had been wired for the broadcasting service with a total of 250 miles of line. At the Electrophone Central Office, 12 operators were assigned the task of connecting specific programs to subscribers upon request.

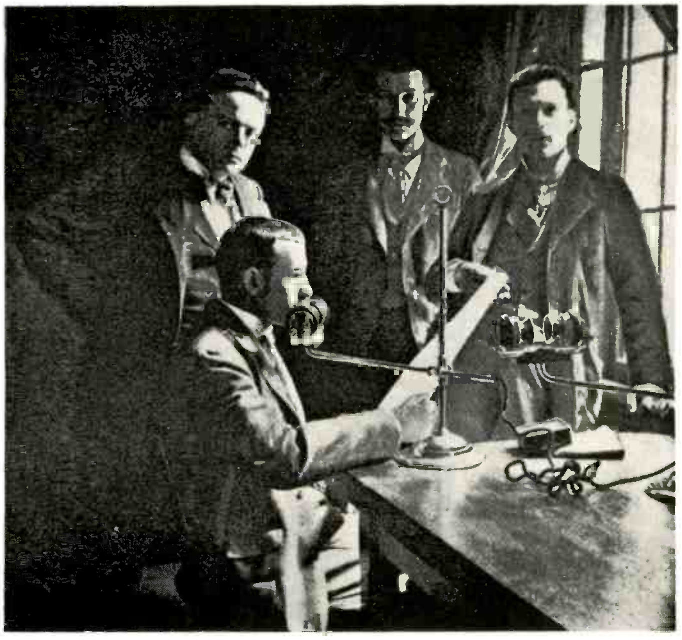


Fig. 14. "Stentor" news announcers at Budapest's TELEFON-HIRMONDO broadcasting station, 1901.

Fig. 15. Music studio on the TELEFON-HIRMONDO, 1901.

Among places wired with electrophone equipment was Covent Garden. Typical stage installations in the first years of the company included Blake and Ader carbon transmitters with shock resistant bases. However, these devices were simply too prone to vibration. The loosely mounted carbon rods caused severe harmonic distortion on loud orchestral passages with a resultant downgrading of signal quality. This was well known by telephone engineers in 1895 from experience of the previous decade. The Electrophone Company, therefore, came up with a specially designed granular carbon transmitter that greatly alleviated the problem.

In any event, by the time of de Forest's epic wireless broadcast from the stage of the Metropolitan in January, 1910, most major opera houses in Europe had a considerable history of closed-circuit transmission from the stage. In retrospect it seems entirely conceivable that wired broadcasting networks could have developed to the point of supplying all basic needs for programmed transmissions to individual homes. This was especially the case since, in 1912, Bell Telephone Company scientists succeeded in producing a reliable vacuum-tube amplifier and gave promise of solving major problems pertaining to line telephone repeaters. However, during that same year the discovery of oscillation in vacuum-tube circuits foreshadowed startling events ahead and it became obvious, shortly, that radio communication would prove to be a much more practical and economical method of reaching the home with entertainment and news information. Wired broadcasting was destined to play a more limited role in the communications industry. It exists today in the form of background music services over leased telephone wires, or in combinations with radio-frequency transmissions whereby a central station picks up a broadcast and retransmits over wire or cable links to reproducting equipment. Regardless of its role today, the 19th Century beginnings in wired transmission produced a number of significant electroacoustical innovations whose full value could not be appreciated for many years. Æ

Build this transistorized

Square- and Triangular-Wave Generator

W. S. PIKE

How to build a simple tool for your audio testing—one which will provide you with your choice of two useful waveforms which can be used in a variety of ways in experimental audio.

NEED A HANDY SOURCE of square waves? Triangular waves? Here's a compact, battery-operated unit capable of producing both. It covers the audio range from 20 Hz to 20 kHz with an amplitude variation of less than 5 per cent. The maximum peak-to-peak output is 2 volts (into open circuit) and the output impedance is about 1000 ohms. The square-wave rise time is about 0.5 μsec, and silicon transistors are used throughout.

Transistorized versions of two well-known circuits, the Schmitt Trigger and the Miller Integrator, are combined to obtain these results. Though there are simpler circuits, the combination has some unique advantages. Among them are the following:

1) The generator is readily designable for any frequency.

2) No ganged controls are required.

3) The linearity of the triangular wave is excellent.

4) The symmetry of both waveforms is easily controlled.

5) The main tuning dial may be given a linear calibration.

As neither the Miller Integrator nor the Schmitt Trigger may be familiar to audio enthusiasts, though they are well known in computer and television circles, let's take a look at them first.

The Miller Integrator is nothing more than an inverting amplifier with its output fed back to its input via a capacitor. It puts to use that old bugaboo of the audio designer, the Miller Effect. The essentials are shown at (A) in *Fig.* 1, and in this figure the capacitance, *C*, is not just the interelectrode capacitance of the tube, but an added external capacitor. For simplicity, bias supplies are omitted and the inverting amplifier is shown as a simple triode. Any inverting amplifier of sufficient gain, using either transistors or tubes, may be used.

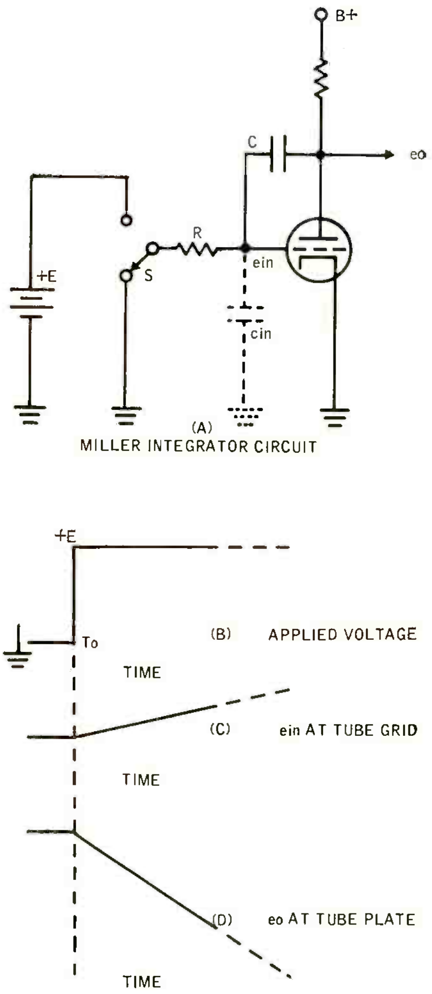


Fig. 1. (A) Circuit of the Miller Integrator—one part of the over-all circuit. Step function (B) applied to the input provides the voltage e_{in} shown in (C) at the grid of the tube, and the output voltage e_o at the plate as shown at (D).

When the circuit is turned on, the triode plate will assume some steady-state potential depending on the bias. Now, at time, T_o, let switch *S* be thrown, applying a voltage $+E$ to the input resistor, *R*. This is depicted at (B). The voltage, e_{in}, at the grid of the tube, will start to rise positive as the *effective* input capacitance C_{in}, is charged through resistor *R*. The time constant is given by the familiar expression:

$$T = RC_{in} \qquad (1)$$

Though the rise of voltage at the grid will be exponential, the *initial* portion is highly linear, with a slope S_{in}, given by:

$$S_{in} = \frac{E}{RC_{in}} \qquad (2)$$

This is depicted at (C). The rising grid voltage e_{in} will be amplified by the tube, with a polarity reversal, and will appear as a linearly falling voltage, e_o, at the tube plate. This sort of waveform is often called a ramp. The slope of the output ramp will be $-A$ times the input-ramp slope, where A is the gain of the stage and the minus sign accounts for the phase reversal. The output ramp is shown at (D). The following expression may be written for the slope S_o of this waveform:

$$S_o = -AS_{in} = -A\frac{E}{RC_{in}} \qquad (3)$$

But our old friend, the Miller Effect, tells us that the *effective* input capacitance C_{in} is given by:

$$C_{in} = C(1+A) \qquad (4)$$

External appearance of the author's generator.

Substituting this into Eq. *(3)* we obtain:

$$S_o = -A \frac{E}{R[C(1+A)]} \qquad (5)$$

Now, if A is much greater than unity, that is to say, if the amplifier gain is high, we can neglect the 1 in the denominator. Equation *(5)* then reduces to:

$$S_o = -\frac{E}{RC} \qquad (6)$$

The A term cancels out. Thus the slope of the output ramp of a Miller Integrator is independent of the gain of the amplifier, providing only that the latter is much greater than unity. In practice it can easily be made 500 or so. The circuit provides a means of generating a highly linear ramp whose slope depends only on a resistor, a voltage, and a capacitor, and not on the possible vagaries of an active device such as a tube or transistor. Observe that the output-ramp slope is opposite to the applied voltage E. The ramp may be made either positive or negative-going merely by reversing the polarity of E.

The Schmitt Trigger

The essentials of our second building block, the Schmitt Trigger (sometimes called a "slider" or "comparator") are shown at (A) in *Fig.* 2. It is a form of flip-flop. The collector of transistor Q_1 is coupled to the base of Q_2 via R_3 and R_5. Transistor Q_2 is coupled back to Q_1 via the common-emitter connection. This is positive feedback; the circuit is regenerative if it is biased into the state where both transistors are conducting. There are two stable states, depending on the input voltage at the base of Q_1.

(B) of *Fig.* 2 depicts the output voltage at the collector of Q_2 as a function of the input voltage applied to the base of Q_1. This type of plot is often referred to as the "transfer characteristic" of the circuit. The transfer characteristic of the Schmitt Trigger has a special kind of non-linearity which is useful for our purposes.

Assume that initially the base of Q_1 is at ground potential, as shown at point A. The chain of resistors, R_1, R_3 R_5 will hold the base of Q_2 at some positive potential. By emitter-follower action, this will hold the emitters of Q_1 and Q_2 at the same potential. The result will be that Q_1 is cut off and Q_2 is conducting. Thus the collector of Q_2 will be at a fairly low potential, as shown at A.

Now, let's gradually raise the input voltage positive. As long as Q_1 stays cut off, no change in output voltage takes place. However, when the base potential of Q_1 reaches approximately the voltage at the emitters of Q_1 and Q_2, Q_1 will start to conduct. This point is shown at (B). Let's call this input voltage E_1. As Q_1 starts to conduct, the loop gain of the entire circuit, which had been zero (remember, Q_1 was cut off) suddenly rises. Regenerative action occurs, driving Q_1 on and Q_2 off. The output voltage at the collector of Q_2 abruptly rises to the supply voltage, E_c. This point is shown at *C*. If the base voltage of Q_1 is raised further it will have no effect on the output as Q_2 is cut off. Thus on a rising input voltage the output voltage follows the path ABCD, triggering occurring at the voltage, E_1.

With the input voltage held at any value above E_1, Q_1 is sure to be on. This will drop the potential at its collector and thus lower the potential at the base of Q_2 below the point at which it stood at the start of the cycle. Consequently, if we now gradually lower the voltage at the input, it will have to fall to a slightly lower voltage than E_1 before transistor Q_2 can again turn on and again make the loop gain other than zero. Hence, as the input voltage is lowered, the output voltage follows the path, DCEFA, triggering back to its original state at a new voltage, E_2, which is lower than E_1. This difference is referred to as the hysteresis voltage, *H*, of the circuit. It can be controlled in magnitude and in d.c. level by selection of R_1, R_3, R_4, and R_5. R_2 does not affect the trigger points as long as Q_2 is not allowed to saturate. The design process by which these values are selected is outside the scope of this paper, but hysteresis voltages in the one-half- to one-volt region are easily obtained.

Combining the Circuits

Having done our homework, we are now ready to combine these circuits. *Figure* 3 shows how it is done. The output of the Schmitt Trigger drives the input of the Miller Integrator via a buffer amplifier. The Miller Integrator output, after power amplification, is fed back to the input of the Schmitt Trigger.

Assume that at the start of the operating cycle the Schmitt Trigger and buffer amplifier apply a voltage $-E$, to the input of the Integrator. A positive ramp will result at the Integrator output. When the ramp voltage reaches the more positive triggering point of the Schmitt circuit, the latter will trigger. The buffer amplifier is arranged so that when this occurs it applies a voltage $+E$, to the Miller Integrator. This causes the output ramp slope to change sign and become negative going. When it reaches the more negative trigger point of the Schmitt circuit, the latter again triggers, reverting to its original state and the cycle starts over again. If the voltages $-E$ and $+E$ are equal, the positive and negative ramps will have equal slopes and the output from the Miller Integrator will be a symmetrical triangular wave. Obviously, the output from the buffer amplifier will be a symmetrical square wave.

The fact that the output amplitude of the triangular wave will be precisely equal to the hysteresis voltage *H* of the Schmitt Trigger makes it easy to predict the operating fre-

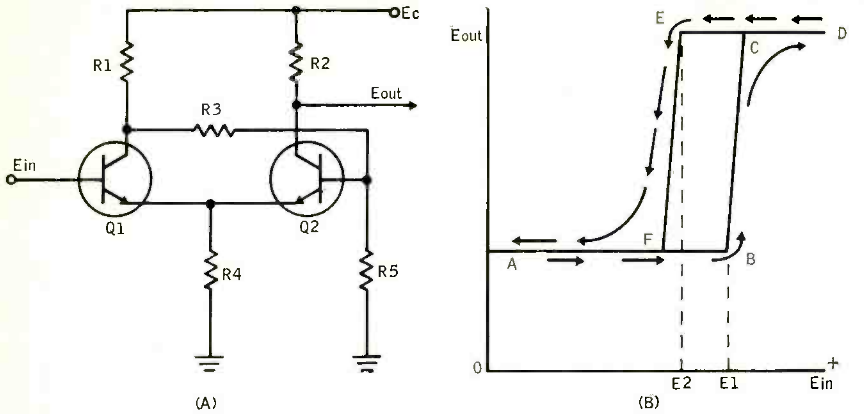


Fig. 2. The Schmitt Trigger—part two of our complete circuit—in schematic form at (A), and its transfer characteristic at (B).

quency. The frequency, F, will be directly proportional to the ramp slope S_o, and inversely proportional to the hysteresis H. Hence:

$$F = \frac{KS_o}{H} = \frac{KE}{HRC} \qquad (7)$$

where K is a proportionality constant. Further thought will show that K turns out to be equal to ½, as each cycle comprises two half cycles. Hence:

$$F = \frac{E}{2HRC} \qquad (8)$$

Equation *(8)* shows that the operating frequency may be varied by changing any one of four parameters, E, H, R, or C. As a practical matter, R is best kept fairly low with transistor circuitry, else the input resistance of the Miller Integrator amplifier will become troublesome. This, in turn, dictates that C will be a goodly fraction of a microfarad in order to reach the low end of the audio range, 20 Hz. Thus, while C may profitably be switched for range changing, it is not attractive for continuous tuning—variable capacitors just don't come that big.

H, the hysteresis voltage, is similarly unattractive. It will vary amplitude simultaneously with frequency. This leaves R and E, either of which is readily variable with a simple potentiometer. We have elected to vary E, as the output frequency is directly proportional to E whereas it is inversely proportional to R. This means that varying E with a linear potentiometer will result in a linear calibration of the main tuning dial. If R is varied, a non-linear potentiometer would be required.

The complete circuit is shown in *Fig.* 4. Note, first, the use of a dual power supply, providing equal voltages above and below ground. This facilitates d.c. coupling the entire generator—a great help in obtaining a 20-Hz square wave free of tilt. Q_1 and Q_2 are the Schmitt Trigger. They drive a four-transistor buffer amplifier, Q_3 through Q_6, the output stage of this amplifier employing complementary emitter followers.

The buffer amplifier fulfills two functions. First, it shifts the d.c. level of the Schmitt Trigger output to a more convenient value for the following circuits. Second, it provides some gain and a low output impedance. It is arranged so that its output swing is equal to the battery voltage less only the drops in the base-emitter junctions of Q_5 and Q_6. Thus the square wave at the top end of P_1, the main tuning control, has its positive half cycle at plus 3.4 volts and its negative half cycle at minus 3.4 volts (with respect to ground). A fraction of this voltage controlled by the setting of P_2 is applied to the input of the Miller Integrator via R_{12}.

The Miller Integrator inverting amplifier comprises Q_7, Q_8, and Q_9, while Q_{10} and Q_{11} are complementary-symmetry emitter followers. The open loop gain of the circuit is at least 500, assuring excellent linearity. Range switch S_1, inserts C_2, C_3, or C_4 into the integrator circuit, thus changing the frequency range of the main tuning control in decade steps.

The output of the Miller Integrator is fed back to the Schmitt Trigger input. As the hysteresis of the Schmitt is about one volt, a compensated attenuator with a loss of about 2 is introduced in the feedback path. The attenuator comprises R_1, R_2, and C_1. This artifice permits the output amplitude of the generator to be greater than the hysteresis voltage by the attenuation factor, hence the stated output voltage of 2 volts.

Resistor R_{11} restricts the range of the main tuning control to a trifle over 10:1. The range-changing capacitors must be accurately proportioned ($C_2 = 10\ C_3$ and $C_3 = 10\ C_4$) if the end of one range is to coincide accurately with the beginning of the next. We combined several capacitors for each of these, measuring the result with a capacitance bridge. The absolute values are of less importance than the 10 to 1 ratio between ranges. R_{12} may be trimmed as much as 10 per cent in either direction, if needed, to compensate for any range shift resulting from all the capacitors being a little low or a little high. We calibrated the main tuning dial using an audio oscillator and Lissajous figures.

Several other points in the design are worth comment. P_2 adjusts the slope symmetry of the triangular wave and the mark-to-space ratio of the square wave. Adjustment of P_2 is most critical at the low-frequency end of the main tuning dial. Using an oscilloscope, adjust it for equal slopes of the triangular wave or for equal mark and space times of the square wave. Do this on the middle range, with the main tuning dial set at its lowest-frequency position. The adjustment centers the operating point of the Miller Integrator between the voltages applied for the positive and negative ramps.

In principle, a much simpler integrator amplifier could be used. However, the differential pair (Q_7, Q_8) shown here, provides improved ther-

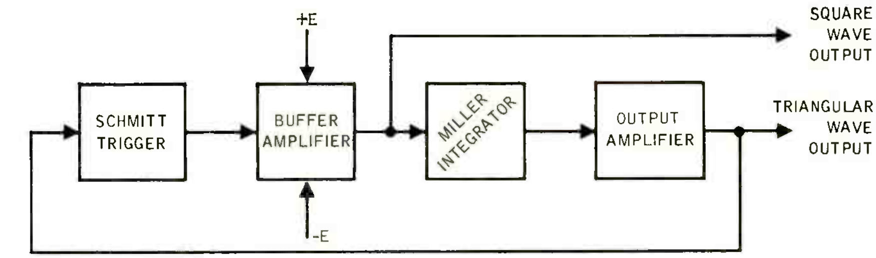


Fig. 3. Block schematic of the complete instrument, showing the sources of the two different output signals.

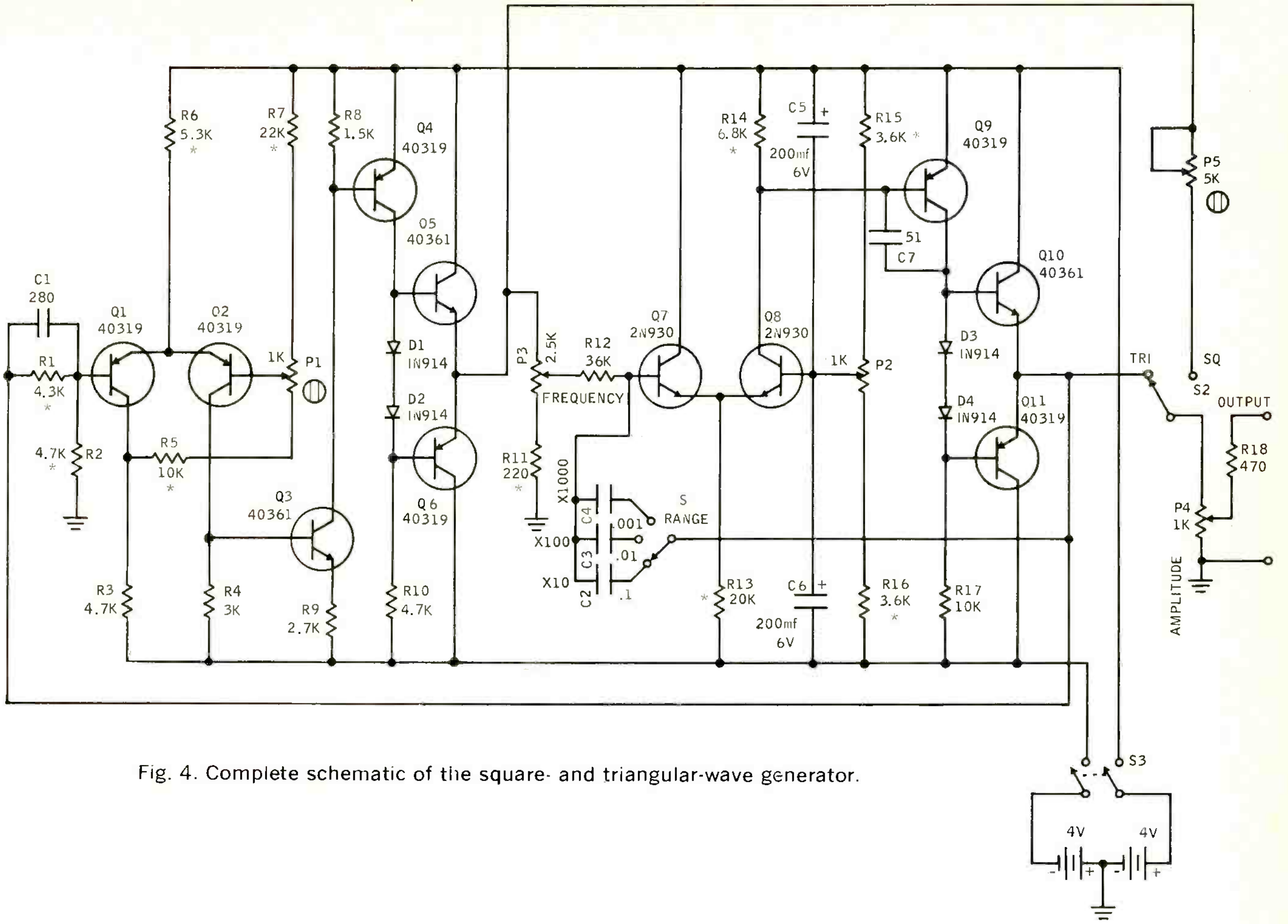


Fig. 4. Complete schematic of the square- and triangular-wave generator.

NOTES:

1. Adjust P2 for symmetrical waveform at lowest frequency on middle range.

2. Adjust P1 for zero d.c. in triangular waveform at same frequency as in Note 1.

3. Adjust P3 to make square-wave and triangular-wave amplitudes equal.

4. All resistors ½-watt carbon, ± 5% tolerance where marked *; otherwise 10%.

mal stability. The use of the complementary transistor, Q_9, following the differential pair, enables the d.c. offset of the amplifier to be made low or zero. In other words, the d.c. potential of the output is the same as the input. C_7 was required in our generator to control the high-frequency loop gain of the integrator amplifier.

Diodes, D_1, D_2, D_3, and D_4 provide bias for the complementary emitter followers. This is a well-known technique for reducing crossover distortion. There is nothing sacred in the type specified and almost any small-signal *silicon* diode may be used.

As noted earlier, d.c. coupling is used throughout. The output d.c. level of the triangular wave may be slightly adjusted by means of P_1, which shifts the trigger points of the Schmitt Trigger. Adjust it to make the average d.c. in the triangular wave precisely zero. A d.c. oscilloscope may be used for this. If you don't have such an animal, adjust P_2 for precise symmetry first, as previously de-

C_1	270 pF, silver mica	Batteries	2 Mallory TR-133R (4.05 V)
C_2	0.1 μF, Sprague 192P10492		
C_3	.01 μF, Sprague 192P10392	R_1	4300 ohms, 5%
C_4	.001 μF, Sprague 192P10292	R_2, R_3	4700 ohms, 5%
		R_4	3000 ohms
C_5 C_6	200 μf, 25 V, electrolytic Sprague 207G025EJ4	R_5	10,000 ohms, 5%
		R_6	5300 ohms, 5%
C_7	51 pF, silver mica	R_7	22,000 ohms, 5%
D_1, D_2, D_3, D_4	1N914	R_8	1500 ohms
		R_9	2700 ohms
P_1, P_2, P_4	1000-ohm potentiometer, linear	R_{10}	4700 ohms
		R_{11}	220 ohms, 5%
P_3	2500 ohm potentiometer, linear	R_{12}	36,000 ohms
		R_{13}	20,000 ohms 5%
P_5	5000-ohm potentiometer, linear	R_{14}	6800 ohms, 5%
		R_{15}, R_{16}	3600 ohms, 5%
Q_1, Q_2, Q_4, Q_6, Q_9, Q_{11}	RCA 40319 transistors (or 2N3638A)	R_{17}	10,000 ohms
		R_{18}	470 ohms
Q_3, Q_5, Q_{10}	RCA 40361 transistors (or 2N2270)	S_1	3-pos rotary, Centralab 1461
Q_7, Q_8	TI 2N930 transistors	S_2	SPDT toggle switch
(All resistors ½ watt.)		S_3	DPDT toggle switch
		Case	See text

Approximate total cost of parts, $45.00

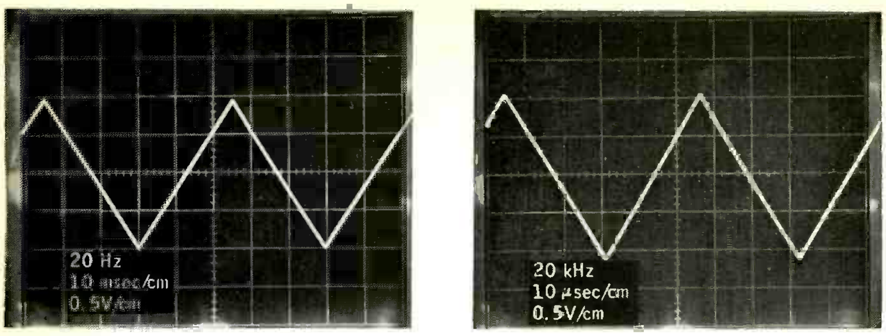


Fig. 5. Triangular waveforms produced by the author's generator—left, 20 Hz; right, 20 kHz.

scribed. After this is done, connect a d.c. voltmeter to the output of the generator and adjust P_1 for zero volts.

Switch S_2 switches the output attenuator to either the square-wave or triangular-wave source. P_5 may be adjusted to make the amplitudes of the two types of waveforms equal. This feature is useful in testing audio amplifiers. For example, the very nature of a square wave sometimes makes it difficult to be sure that an amplifier under test is not clipping. Using this generator, if you suspect overloading, switch to the triangular wave output. If peak clipping is occurring it will be readily visible.

The compensated attenuator, R_1, R_2 and C_1, in effect "fools" the Schmitt Trigger into thinking that the triangular wave is smaller than it is, thus allowing it to exceed the hysteresis of the trigger circuit as stated earlier. At the top end of the frequency range, the frequency response of the attenuator becomes a matter of concern, hence the compensation capacitor. Try the effect of removing it. You will probably notice that the triangular wave output of the generator increases slightly in the region from about 8 kHz up. This is undesirable.

Construction poses no problems. Our version of the completed generator is shown on page 25. We wired it up on a piece of phenolic board using push-in "flea clips." Layout is not critical. We used a wooden case, but the entire generator could easily be fitted into a 3″ x 4″ x 5″ "Minibox."

There are very likely other transistors which could be used. One attractive possibility is the use of only two types. For example, the 2N3638A might be used for all PNP types and the 2N3643 for all NPN units. Both are relatively inexpensive. Another choice would be the RCA 40361 and 40319. However, the integrator transistors, K_7 *and* Q_8 must have a high Beta at low current. For this reason the relatively expensive 2N930 has been specified for these transistors.

Performance is shown in *Fig.* 5, 6, 7, and 8. *Figure* 5 depicts the triangular-wave output at 20 Hz and 20 kHz, and *Fig.* 6 shows the square-wave output at the same frequencies. *Figure* 7 shows the rise and fall times of the square wave, using a higher writing speed and delayed triggering arrangement on the oscilloscope. Note that both rise and fall are of the order of 0.5 μsec.

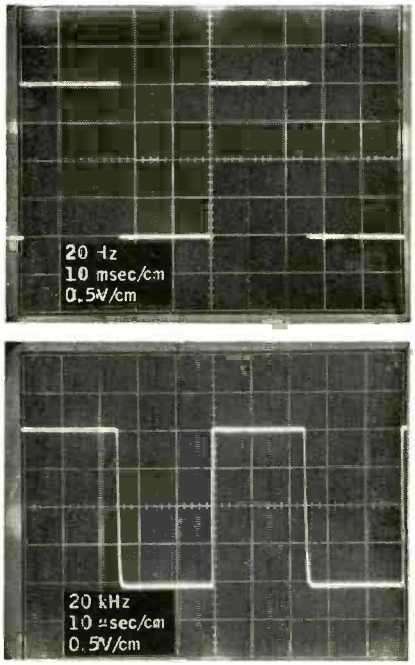


Fig. 6. Scope patterns produced by the generator at the square-wave output—upper, 20 Hz; lower, 20 kHz.

The reader is cautioned that these waveform photographs were taken on a wide-band laboratory oscilloscope with response from d.c. to 10 MHz. (Anyone for Mega Avis?) If your oscilloscope is an inexpensive one having restricted bandwidth, it may not faithfully reproduce the generator waveforms at the range extremes. To check this, we connected the generator to a well-known make of inexpensive kit oscilloscope with a response stated to be ±2 dB from 2 Hz to 200 kHz. Note that this response extends precisely one decade above and below the generator range extremes. Sure enough, a 20-Hz square wave showed about 12 per cent tilt. Similarly, quite perceptible rounding of the 20 kHz square wave was evident. If you observe such phenomena on your oscilloscope, dig out the instruction book and check its specifications before blaming the signal source.

In closing, we should point out that the basic circuit is readily modified for other purposes. By shunting R_{12} (*Fig.* 4) with a diode in series with a second resistor, controllable assymetry may be introduced. This scheme has been used to generate sawtooth waveforms with accurately controlled retrace times for television deflection systems. In a less dignified application, the circuit has been used as a source of variable-duty-cycle pulses for model railroad speed control. In this application the duty cycle was made continuously variable by changing R_{15} and R_{16} and increasing the value of P_2. Capacitors C_5 and C_6 in this case, obligingly provide delayed "throttle" response. The circuit, as shown, must, of course, be followed by a power transistor in order to switch successfully the higher currents involved in most model-railroad applications. Æ

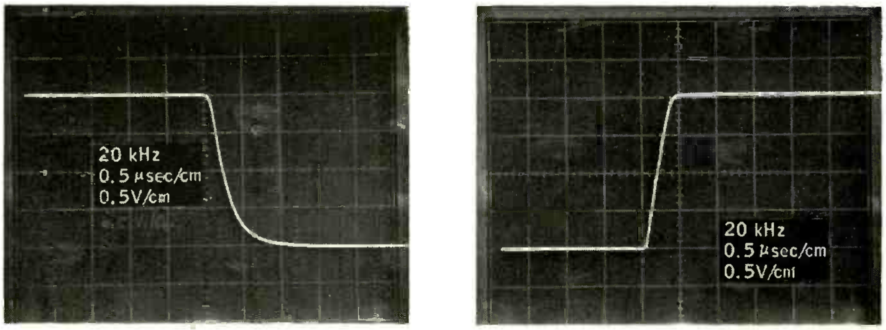


Fig. 7. Details of 20 kHz square wave on expanded scope scale to show rise and fall times approximating ½ microsecond.

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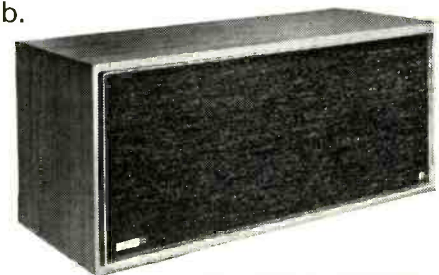

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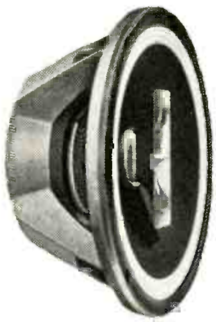

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Isaac Stern and his Music – and his Music System

What this famous concert and recording violinist thinks about music, musicians, concerts, and recordings, and his outlook on the quality of a reproducing system from the viewpoint of a musical perfectionist.

LEONARD SILKE

THERE WAS QUITE A BIT OF LOGISTICS required to marshal the people necessary to visit with and photograph famous violin virtuoso Isaac Stern. For one thing, we journeyed from Philadelphia with a photographer and our art director. Our destination was the Central Park West duplex occupied by the Stern family. We were to rendezvous with reviewer Oscar Kraut, who helped set up the date, and Harry Cykman, who designed the elaborate Stern audio system seen on the cover. It is interesting to note that both Mr. Kraut and Mr. Cykman are functioning professional violinists.

We were ushered into a panelled library on the lower level of the duplex. The view overlooked the park, still rather stark with the aftereffects of winter's ravages.

Stern was not yet down. He had, after all, come home only the night before from an extended tour. We later saw that his bags had not yet been unpacked.

We didn't have long to wait. I had just set up my portable Norelco when he came bubbling in. He immediately spotted my recorder; this stopped him for a moment. It seems that he has several and he thought this one was one of them. With that explained away he settled down behind a desk for our talk.

Isaac Stern appears close up much as he does on stage. He is rather short and rather portly. But there is a high-key wiriness about him that is intense. He laughs easily, seems to enjoy a joke (even his own), and talks freely and well.

After I explained what areas I wanted to discuss, the stage was set by his simple comment:

"Ask any question you wish. There are no embarrassing questions; only embarrassing answers."

We began with a discussion of recording technique, this led to the question of "snippet" recordings. That is, the super-perfect final recording that represents something far in excess of what the artist can do. This is a recording which is done in bits and pieces, each section honed to perfection, and then spliced into a continuous whole.

Violinist Isaac Stern in his Music Room/Study.

Stern smiled, "Of course, I can't speak for everybody in the field, because I don't know what their recording habits might be. I do know that for myself, my accompanist, with orchestras and small groups with which I record, and from discussing this problem with fellow artists, that there is a swing away from this sort of thing.

"There was a time, at the beginning of tape recording, when everyone was so enchanted at the chance to snip here and snip there, that they began to play at this as if it were a game. They would put in this note here, that one went in there; a singer could get that high note right where it was wanted. I understand that some artists "painted" in notes that might not even exist."

Stern continued. "I think that more and more tape has come to be used by the serious artist in quite a different way. Almost everyone I know tries to make a base take of the complete work. In this way you get a sense of continuity that is lacking in "snippet" recording. This is imperative to any musical performance. You must have a performance in which the entire flow of ideas melts into one concept, with a beginning, a middle, and an end. This cannot be contrived. Any sensitive musician will instantly recognize whether it is there or not.

"Now in the course of recording there may be a slight error here or there. There is more and more willingness, these days, to let them pass. It is the glaring one, or where something breaks down where later you will re-do a section, a *small* section, that cannot in any way interfere with the flow of the performance. It is rare these days for a performance to be made up of bits and pieces. The economics of recording argue against it. The cost of recording time per hour is such that it mitigates against ultra-careful recording and retake after retake to fix little mistakes."

To many listeners, a modern recording has come to substitute for live performance. It represents a degree of perfection and a kind of sound that cannot be achieved in the concert hall. There are differences in listening perspective, but most important is the concept that a recording does represent a performance that is more technically perfect than is likely to occur in the concert hall.

Stern agreed with this thought but came to the defense of recordings as they are. He feels that live performances and recordings should complement each other not act as substitutes. As for the differences in these two media, ". . . you are quite correct. The recording represents a perfect performance such as is not heard in the concert hall. But nobody listens to a record the way they listen to a concert. They use a different set of ears, they use a different set of standards. With a recording you are glued to every sound because you are focussing down onto it. You are unaffected by the personality of the performer or the appearance and quality of the concert hall. The magic that exists in a live concert does not come over in a recording. A concert is an interplay between performer and audience. A performer, no matter how passive he may be, responds to the *happening* that is the essence of a live performance.

"The player is on stage because he has a feeling of this sensitivity to interplay. He is there to say something to people that he cares about; also to impose his will. At the same time, the audience also makes its demand upon the performer. You may sometimes feel a part of this when you listen to a recording that is taken from a live concert performance. But for the most part this sense of happening is missing from a recording. It is this absence that must be compensated by other means.

"So you settle for something else that represents a different area of excitement. It is very hard to gain the same kind of subtle, musical creation that can happen at a concert. So the record makes its own demands on the performer and listener."

Coffee was served at this point, and in the light conversation that followed I came to realize the depths of Isaac Stern's interests. He is intently aware of the technology that surrounds him. It has given him much food for thought. So I feel that the opinions he expresses are of great depth. Stern does not give me the impression that he makes up his thoughts as he goes along. At the same time, there is hardly a field related to music—live or reproduced—where he has nothing to say.

After the coffee went down we continued to talk about the sound of records and the effect they have on the musical listener.

"I think it is nonsense when a soloist is heard out of all proportion to the strength of his instrument. This happens so often when a recording is designed to feature a personality. I have often rebalanced a record to avoid my speaking out in front of the orchestra, my face hanging out.

"But, you know, talking about the sound of recordings, there are some works that might seem to actually sound better on records. Take, for example, the Alban Berg Violin Concerto. This is a work with a marvelous plan, a massive compilation of information. This is particularly true in the coda of the last movement which has a structural shape on paper which tends to sound rather confused in actuality. On recordings, by amplifying the line of the strings over the brass, or controlling the amount of the general crescendo in a way that cannot be done in the concert hall, you can guide the ear and make it follow a line. In the concert hall, the ear becomes confused and, like the eyes, begins to search from side to side looking for the line. On the record, however, you have the ears under control, so you simply guide them to the proper lines."

As with all concert musicians, Isaac Stern is disturbed by the increasing interest in recordings *in preference* to live performance. But when I stated that it seems to be mostly the casual concertgoer that is so affected, Stern retorted with, "Well, if he is casual, it doesn't make much difference, does it?"

Stern does not feel that a great deal should be done to convert the casual listener into one more devoted. He does not believe in spoon-feeding music.

". . . people should realize that they are privileged, they are lucky to learn what music is all about. I don't think that we have to make people believe in music or force them to make their minds pay attention to you. Music is more important than these people; it has lasted a lot longer than they have; and it will continue to last a lot longer after them. But we do need to give them the *opportunity* to come and listen and to be willing to be moved. That's all."

At this point the discussion moved over to some of Stern's concert plans. Over the last ten years he has played an average of 150 to 160 concerts per year. In addition, there are many recording dates for Columbia records. Is it any wonder that we caught him at home one day after he came in and three days before he was going out again?

"I just pack my bag, go and play a concert, pack it again, go and play another concert."

But this year he promises to cut back, travel a little less, and enjoy his home a bit more.

Stern was active in the early Casals Festivals in Puerto Rico, but he minimizes his role in them.

Isaac Stern on Pablo Casals:

"Casals and I are close friends. We've made music both publicly and privately. We've talked a great deal. He is, I think, a unique and special figure in our time. Not so much for what he does in music, but how he approaches his music. His approach is uniquely his, it cannot be transferred from artist to artist."

Isaac Stern on his music interests:

"I have recorded or played the bulk of the major contemporary violin music. Contemporary not in the sense of the *avant-garde* but rather up until the *avant-garde*.

Isaac Stern on the *avant-garde:*

"I'm not sure where *avant-garde* music lies. For that matter, I'm not sure where the whole course of music lies as relates to our *avant-garde*. But more to the point, I'm not sure that *they* know.

"Still, one must be hesitant because, if you know your music history, you learn to be more careful in making finite judgments. At the same time, you cannot be a person of taste without having an opinion. You *have* to have an opinion.

"I think that when it comes down to it for the moment there is that great coalescent fact that the *avant-garde* suffers from the lack of a real talent to come along and bring all the elements

Close-up of Mr. Stern's music system control center. Note the uniformly high quality of the components.

together and fuse them into a direction."

Music Systems

With records so important a part of Stern's life and work, and being the person of vast interest that he is, he has naturally gravitated toward component systems as providing the kind of sound he can live with.

He disclaims being a hobbyist, yet he knows almost as much about the equipment as many an AUDIO reader. He is an amazingly quick study. According to Cykman he grasped the complexities of his two-track Crown recorder as quickly as it was explained. Stern personally selected by audition the equipment he owns. Cykman designed the cabinets and completed the installation for him.

Stern has some positive ideas about the purpose of high-fidelity equipment.

"Well, I expect the equipment to be capable of re-creating as closely as possible the quality of sound and the intent of the performer. And it must do this in the most natural form possible. I think that my present equipment does that for me."

I reminded Stern about the audio fable that makes musicians incapable of judging equipment properly because of the perspective with which they normally hear music. After all, how many recordings, no matter how closely miked, really sound the way a violin does when you hear it from the vantage point of having it tucked under your chin.

"That's right, I've never heard it anywhere the way I hear it when I'm playing. But I know that I never will hear it that way. Nor can anyone ever hear it that way. While you are performing, you are just too much inside the music."

Stern continued, "This sets off a whole series of interrelated problems. Recordings are a quasi-art form unto themselves. And being an art form, it must fulfill the basic function of art by being bigger than life. Because hearing what you hear in your room is not enough. That is the basic malfunction of most modern concert halls created by engineers rather than musicians. The very essence of a hall, of a concert, of a *happening* for the performer is that something happens that *is* larger than life. The hall should envelope you, cup you, raise you to heights you cannot reach in an ordinary room.

"Well, the same thing must happen in a recording. Therefore, the recording must have an aura about it that the listener suddenly responds to. The sound must be more than simply that of a little horn in his room.

"The professional, however, wants to have equipment that can do both. He wants to be able to appreciate the super quality that has been built in, but he also must have equipment that can strip the extraneous qualities and get down to the meat of the performance for his own study purposes. This is pretty hard. It means he must have equipment that will reproduce what has been done, and yet can counteract what has been falsely done."

Recordings can create their Frankensteins. Stern had nothing complimentary to say about artists—classic or popular—that are creations of the recording art and cannot hope to duplicate what their discs say.

"Here is where live music and recordings clearly part company. Recordings have created, particularly in the pop field, certain notoriety for people who could not ordinarily be heard in the same room with a softly whistling tea kettle. And suddenly they have such huge voices. But put them on a stage and they disappear.

"In classical music there have been certain European groups who have created reputations by virtue of their recordings. But when they come here in live concert, you come to the conclusion that they must be having an off night. *Every* night?

"On the whole, though, that has gone by the boards. By now everybody knows that a record is a public document. Sooner or later, you will have to live up to it, and woe be to you if you cannot.

"On the other side of the coin, I know certain great artists who did not record as well as they actually are themselves in life. To a very great extent this is because of that interplay I spoke about before. These artists cannot function without the return flow from an audience."

"Perhaps it can all be best summarized this way. Recordings are marvelous and necessary functions, serving as partial memories, slightly inexact and highly personal reminders of the practice of a great art. They are also valuable as an introduction or as an exciter to the possibility of entering the actual arena of great performance, for which there is no substitute."

So ended our formal conversation. We went up to the second level, to Stern's work, rehearsal, listening room. This is where much of the unpacked material of his most recent tour was kept. We pushed it aside and took our photographs. I must say that photographs do not tell how well such a system sounds, nor do they give more than a mere hint at the beauty of the two wooden chests (designed by Cykman) that house the equipment. All wiring, including that to the speakers located toward the windows, is concealed.

No one will deny that Isaac Stern is a great talent. Some violinists have a playing tone that is described as *cold* or *sterile*. More and more, I come to suspect that this is an extension of the artist's personality. Stern as a man, exudes warmth, humor, and sincerity. This is the characteristic, too, that is to be heard in his music.

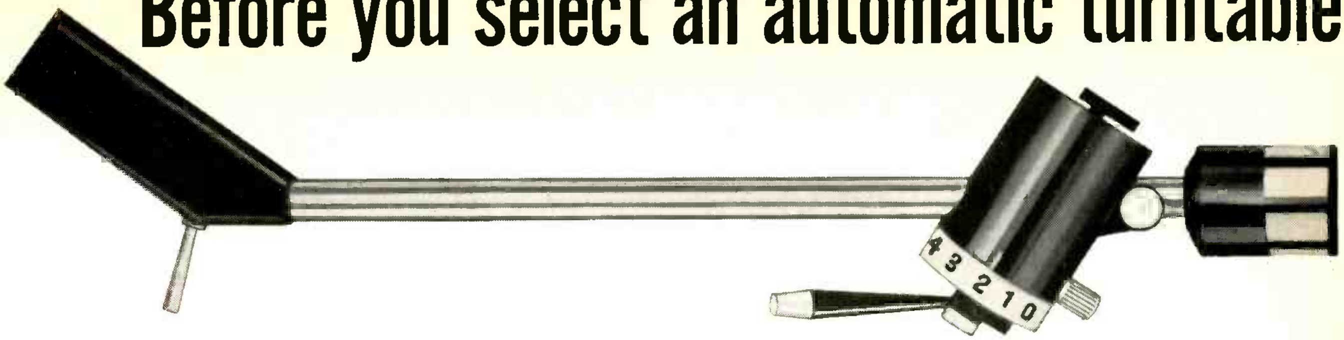
At the same time, there is a humility to the man and his music. He is a man of strong personal conviction, strong opinions certainly, but not *opinionated*. In spite of a formidable performance schedule, he has found time to be busy in a great many organizations. It was Stern that lead the successful fight to save Carnegie Hall from the wrecker's ball.

Isaac Stern is deeply dedicated to music. But not so much so that he shuts out the rest of the world. Quite the contrary, his boundless energy is constantly seeking new areas of service, new ways to place his time, his effort, and his money, to the good of the community.

That is the mark of a great artist. Æ

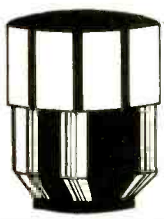
Close-up view of Mr. Stern's tape recording installation.

Before you select an automatic turntable

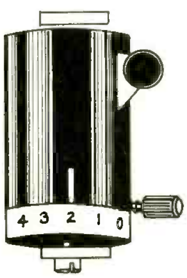


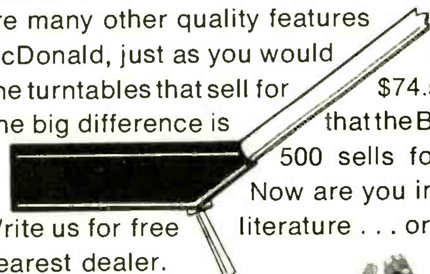
let us arm you with the facts.

Probably the most critical way to evaluate the quality of any changer is by closely inspecting the tone arm and its capabilities. Let's examine



the tone arm of the BSR McDonald 500 automatic turntable. This is the resiliently mounted coarse and fine vernier adjustable counterweight. It counter-balances the tone arm both horizontally and vertically and assures sensitive and accurate tracking. Here you see the micrometer stylus pressure adjustment that permits ⅓ gram settings all the way from 0 to 6 grams. This assures perfect stylus pressure in accordance with cartridge specifications. Here's another unique and valuable feature . . . the cueing and pause control lever that lets you select the exact band on the record, without fear of ever damaging the record or the cartridge. It even permits pausing at any point and then gently floats the tone arm down into the very same groove! Whenever the turntable is in the "off" position the arm automatically returns and securely locks in this cradle to protect it and keep it from movement. This is the low-mass tubular aluminum pick-up arm . . . perfectly counter-balanced both horizontally and vertically to make it less susceptible to external shock. Of course, there are many other quality features on the BSR McDonald, just as you would find on other fine turntables that sell for $74.50 and higher. The big difference is that the BSR McDonald 500 sells for much less. Now are you interested? . . . Write us for free literature . . . or see it at your nearest dealer.





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Audio Measurements Course

NORMAN H. CROWHURST

Part 16

A complete discussion of the development of a 50-Hz high-pass electronic filter circuit employing transistors as the active elements. The methods are shown step-by-step in a manner easy to follow so as to achieve similar results.

Several readers have asked advice about designing a filter of one kind or another. They favor an electronic type, to avoid the problems into which inductor/capacitor designs lead. The first thing to do then is to select a suitable element about which to build—tube or transistor.

Earlier articles have covered tube circuits for this purpose[1, 2, 3], so we'll assume the choice here will be transistors. This will be a good illustration about how to conduct measurements in the development of transistor circuits.

Type Measurements

The published data may or may not include details of input resistance as well as current gain under various operating conditions, along with expected deviations in these parameters from sample to sample of the same transistor type. Seldom will all this information be available on the data sheet, so you will need to find out the information for yourself.

Suppose you've decided that you'll use a collector resistor of 1000 ohms. This is an arbitrary but fairly logical choice. Set up a transistor socket with a 1000-ohm resistor in the collector lead and a resistance box in the base lead (*Fig.* 16-1). Now, with a voltmeter from collector to emitter, adjust the base resistor until the collector voltage is half the supply voltage.

If the supply voltage is 12 volts, adjust the collector voltage to 6 volts. This will mean collector current is 6 mA, because the collector resistor is 1000 ohms, dropping the other 6 volts. If the base resistor to achieve this proves to be 200k ohms, the base current is 60 μA (12 volts across the 200-k resistor). This mean static current gain is 100 (6 mA divided by 60 μA).

To measure dynamic, or a.c. gain, output must be compared with input. Input must be measured in current, by introducing signal through a known series feed resistor. If the series resistor is 100k ohms (*Fig.* 16-2), every volt measured at the input end will represent 10 μA input current to the base.

The measure of output is also in current. A 'scope can conveniently be used to measure gain, by calibrating its deflection in both directions.

Assume that 2 volts rms input yields 2 volts rms at the collector: this represents 20 μA input (rms) and 2 milliamps output; this is a dyamic current gain of 100. With individual transistor

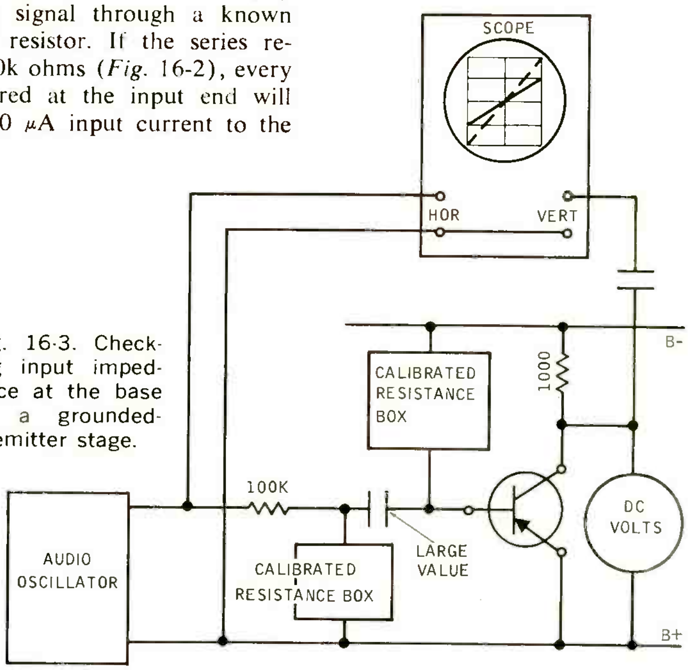

Fig. 16-3. Checking input impedance at the base of a grounded-emitter stage.

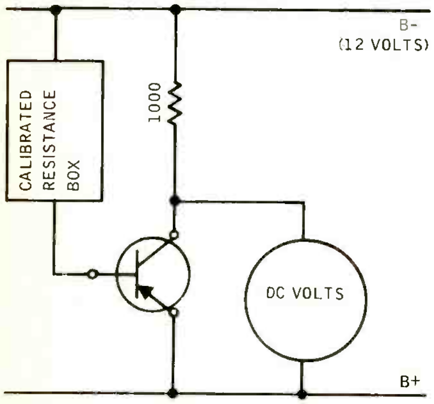

Fig. 16-1. Simple circuit for checking static current gain.

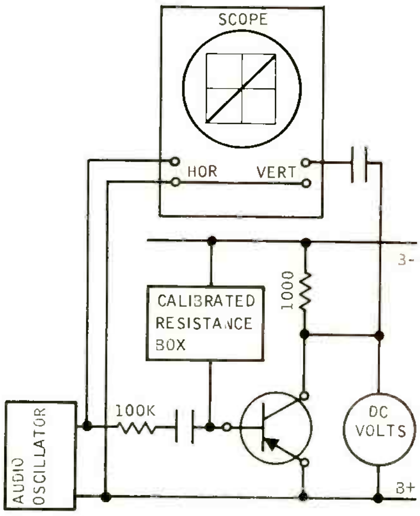

Fig. 16-2. Circuit for checking dynamic current gain, using oscilloscope as indicator. Audio voltmeters could be used instead.

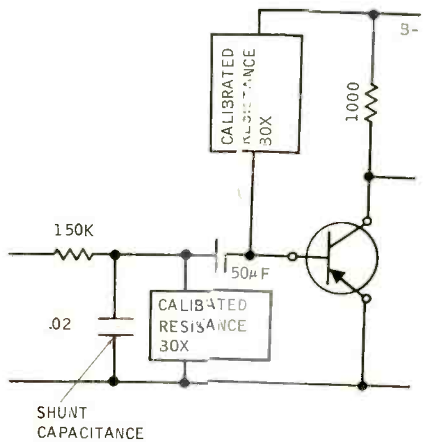

Fig. 16-4. Using a shunt capacitor to assist in closing the loop on the oscilloscope trace.

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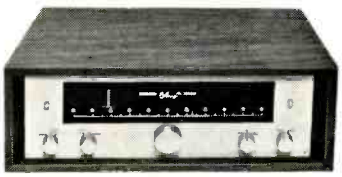

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types you may find the dynamic gain more or less than the static gain (measured as in *Fig.* 16-1) but they will usually be of the same general order.

Next, if you are designing a circuit, you measure a number of samples of the same type, and calculate the static and dynamic gain for each sample measured. This will tell you how much variation you can expect. Suppose the value varies from 70 to 140, with most of them falling close to 100. This shows what you have to design around. The performance of the circuit should not be affected too much if the transistor gain varies between these limits.

One more thing you need to know: input impedance. For this you need another resistance box, connected across the a.c. input at the base (isolated only by the coupling capacitor, which must be large enough to have negligible reactance at the test frequency, *Fig.* 16-3). Adjust the resistance of this box until the output voltage, or the slope of the line, is exactly halved.

Even with a large coupling capacitor, there will be some phase shift. This can be offset by shunt capacitance, of suitable value, and adjusting the frequency to close the loop (*Fig.* 16-4). If the series capacitor is, say, 2500 times the shunt (e.g. 50 μF series electrolytic and .02 μF ceramic shunt) the frequency will be where the impedance is a mean and phase shifts of about a degree mutually cancel one another. If input impedance is, say 500 ohms, frequency will be about 300 Hz for a closed line with the capacitors suggested.

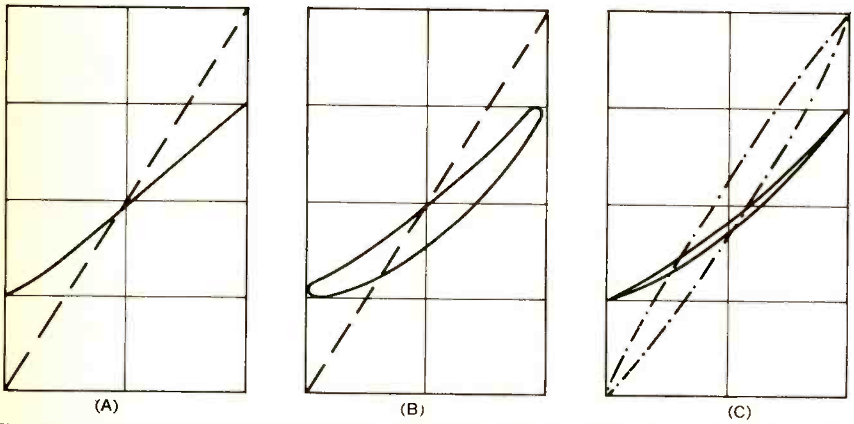


Fig. 16-5. Some traces in base-input measurement. In each case, the solid line is the trace with the shunt resistance added, the dashed line shows the effect of removing it. (A) shows the simple curvature when shunted down, assuming the coupling capacitor is big enough to avoid any phase shift at the test frequency. (B) shows phase shift as well as curvature when shunted down. (C) shows the effect of shunt capacitance to neutralize phase shift in the shunted-down condition.

If output voltage with no shunt resistor is 2 volts, adjust the shunt resistor so that it reduces the output voltage to precisely 1 volt. You may notice that the transfer line is now curved (*Fig.* 16-5). This happens because the input resistance of the transistor is non-linear; shunting it by a linear resistor of equal average value makes the input a compromise between sinusoidal voltage and sinusoidal current, where the unshunted high-resistance feed had provided sinusoidal current input.

The non-linearity shows the need for linearizing input resistance, unless the feed resistance to be used in the actual circuit (including any reactance effects) is high enough to ensure constant-current input. A 10-ohm emitter resistor will add an approximately linear resistance of about 1000 ohms (assuming dynamic current gain to be 100) to the previous value of measured input resistance (*Fig.* 16-6). Check input impedance under this condition, to see whether the change in value follows prediction and whether linearization is adequate.

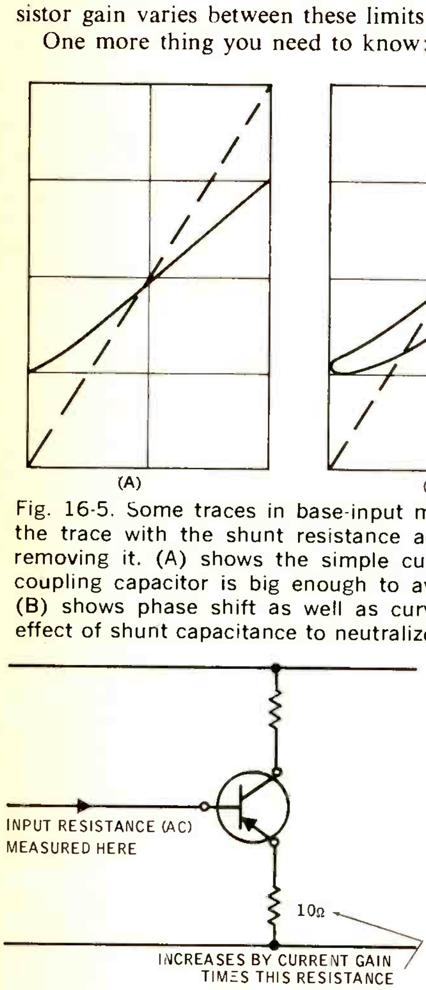


Fig. 16-6. Use of emitter resistor to increase and linearize base input resistance.

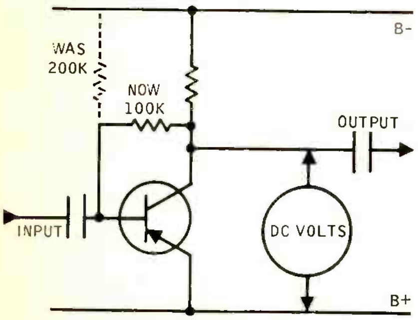


Fig. 16-7. An alternative form of biasing that stabilizes gain.

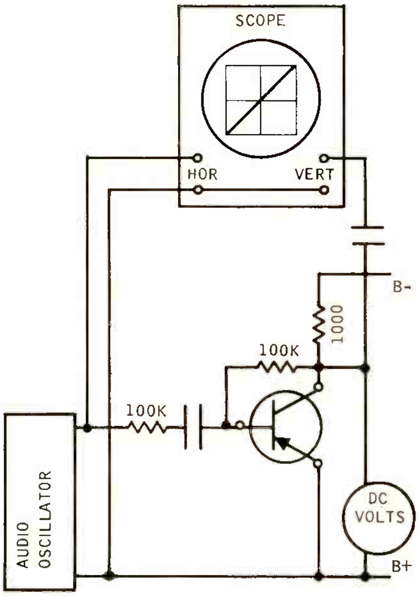


Fig. 16-8. Checking dynamic gain with the revised bias method.

You have checked that the average current gain (static or dynamic) is 100 and that variation occurs between 70 and 140. The next step is to design a circuit that will reduce the effect of these variations to a degree that allows consistent performance.

One way to stabilize gain is to take the base-bias resistor from the collector, instead of the supply point (*Fig.* 16-7). If you halve the value of the bias resistor needed to make collector voltage half the supply voltage, the bias current will remain the same and collector voltage will remain at half the supply voltage, all for the average current gain.

Having set this new bias resistance, which would be 100k ohms in this example, try various sample transistors in circuit and check collector voltage and current gain (*Fig.* 16-8). Collector voltages will fluctuate between 5 volts and 7 volts, with corresponding gains varying between 58 and 41 (gain is 50 when collector volts hit 6 on the nose).

This is more deviation than you can tolerate to give reliable response performance, so you lower the bias resistor. Using a 50k-ohm resistor gives an average collector voltage of 4, with

variation from 3.2 to 5 and gain varying from 37 to 29 (average 33). Try dropping the bias resistor to 33k ohms. Average collector voltage is now 3 volts, with variation from 2.3 to 3.8. Gain averages 25, varying between 23 and 27. This is acceptable, possibly.

Now measure the input impedance by shunting down, with the 10-ohm resistor in the emitter lead (if it wasn't there for the gain measurements it won't make much difference to gain, measured with a high-resistance source). As before, adjust the shunt resistor to have the output (*Fig.* 16-9).

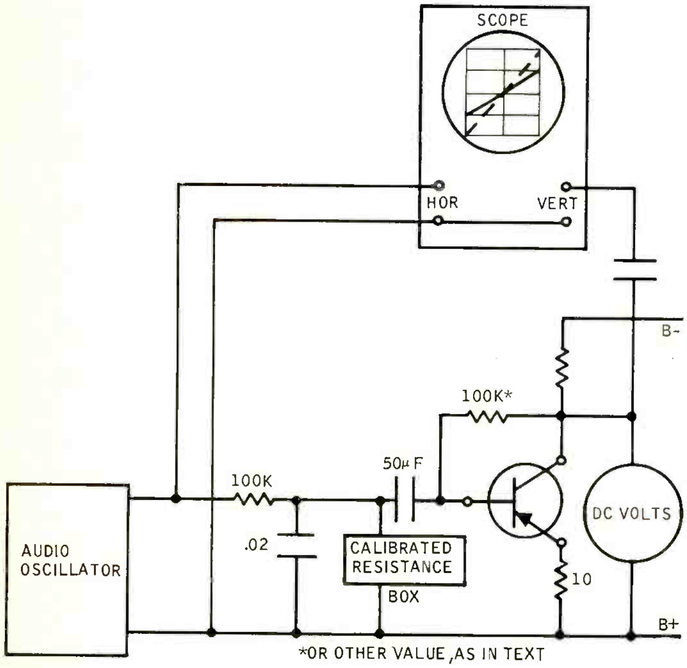
The input resistance averages 250 ohms, varying from 230 to 270, to correspond with the gain variation of individual transistors. Also the waveform remains quite linear when the a.c. input is shunted down with 250 ohms. This begins to look good.

Filter Building

The next step is to add on a couple of capacitor rolloffs and begin planning the filter. The voltage gain is 100, because the impedance changes from 250 to 1000 and the current gain is 25. We have to reduce gain by a feedback factor of 8, to produce the necessary sharpening of the response. So the fed-back signal must be 7 times the original input signal. This means output will be slightly more than 3 times input (in current) without any attenuator to provide needed isolation.

From this point on it is good to work in voltages and currents. This will catch any difficulties due to unusual levels, as well as making the circuit concepts easier to visualize.

Suppose the base input is 20 μA, 5 mV (a.c.) giving 500 μA, 500 mV output. Feedback must attenuate this down to 140 μA to go intto the base circuit (7 times input). But the 500 μA are already dissipated in the 1000-ohm coupling resistor, so the 140 μA must be found additionally. We could raise the coupling resistor to 1500 ohms, so its part of the output signal current is only 330 μA, and then use a 3300-ohm load following the capacitor, which will receive 165 μA. This



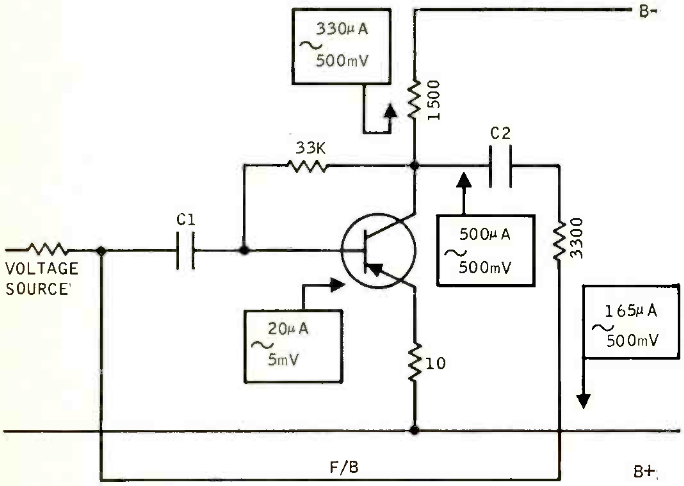


Fig. 16-9. Checking input impedance with revised biasing and an emitter resistor. Fig. 16-10. Basic circuit for feedback filter, first try discussed.

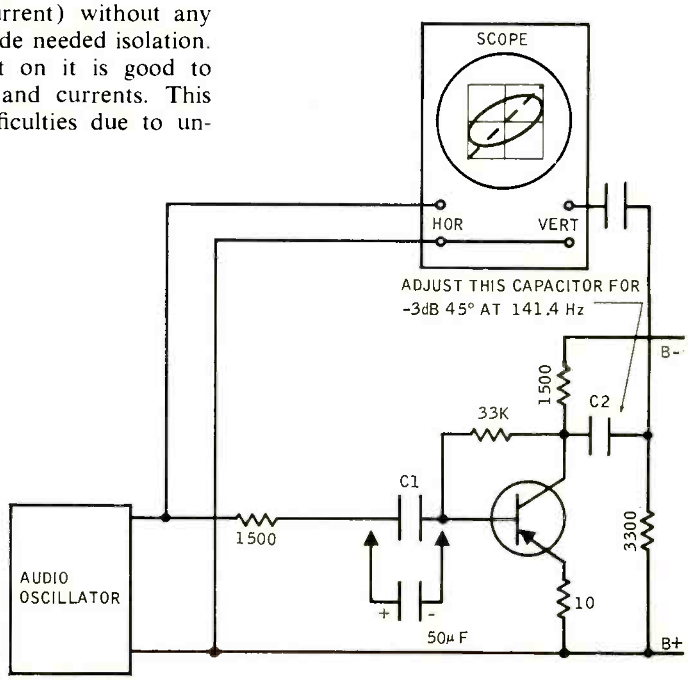


Fig. 16-11. Adjusting the output coupling capacitor.

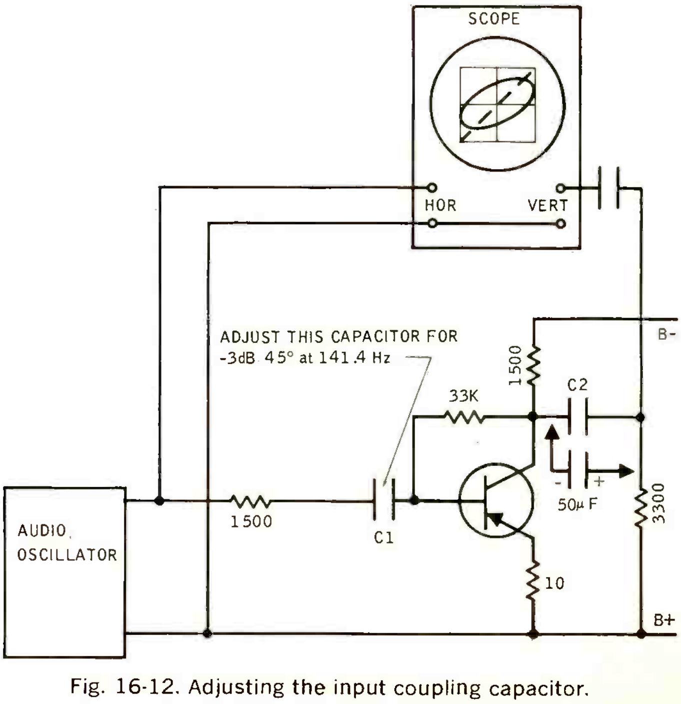


Fig. 16-12. Adjusting the input coupling capacitor.

will also be the feedback resistor (*Fig.* 16-10).

The feedback is applied to a point before the input capacitor and the input feed should be through a resistor that will accept the 25 μA of surplus fed-back current (165 − 140). The input resistance of 250 ohms accepts 140 μA, so the source resistance should be about 1500 ohms to take 25 μA of the feedback.

With these values try the circuit out. First bypass the input capacitor with a large value (say 50 μF) return the feedback resistor to ground and adjust the output capacitor to get a roll-off of 3 dB, 45 deg. at 141.4 Hz (*Fig.* 16-11). Prediction says this will require a reactance of 4800 ohms (1500 + 3300) requiring a capacitor of 0.235 μF. Actual adjustment of capacitor value, so the 3-dB, 45-deg. point is at 141.4 Hz confirms this, within resistor tolerances.

Now bypass this output coupling capacitor with 50 μF and adjust the input-side capacitor, which should be about 1750 ohms reactance (1500 + 250 ohms) or 0.64 μF (*Fig.* 16-12). This checks, too.

Now try both together, by removing the 50-μF bypass, with the 3300 ohms still returned to ground (*Fig.* 16-13). Now the 6-dB, 90-deg. point should be at 141.4 Hz, just summing the effects of input and output capacitors.

But it isn't. Interaction is occurring, between output loading and input, that we never experienced in tube work. The 6-dB and 90-deg. phase points don't even coincide. The 90-deg. point comes at nearer to 8 dB loss and the frequency is about 163 Hz, not 141.4.

Maybe we can compensate for interaction, when we know where we want to go. Let's plan on using about 22 dB of feedback, instead of 18 dB, which the design chart shows would pull up the response from an 8-dB, 90-deg. point, instead of a 6-dB, 90-deg. point, assuming pure R-C design. This change requires a fed-back current of 250 μA for the 20-μA base input, so we split the original collector load into two 2000-ohm resistors (*Fig.* 16-14). This drops collector volts some more, to about 2 volts average, which is still a workable figure.

Change the input and output capacitors to get the 141.4 Hz turnover, as before, with these new values, so the combined response is −8 dB and 90 deg. at this frequency. Actually we shall probably have to shift this frequency too, because 22 dB of feedback will be expected to shift the frequency down further than the 18 dB of feedback would have done. Now connect the feedback (*Fig.* 16-5). We should have the 90-deg. phase-shift point somewhere below 50 Hz and with 3 dB greater than mid-band gain (*Fig.* 16-16).

But the peak doesn't materialize. The 90-deg. phase shift is above 50 Hz and the attenuation is beginning already at this frequency, with no peak. Obviously a single stage of this type isn't going to do it.

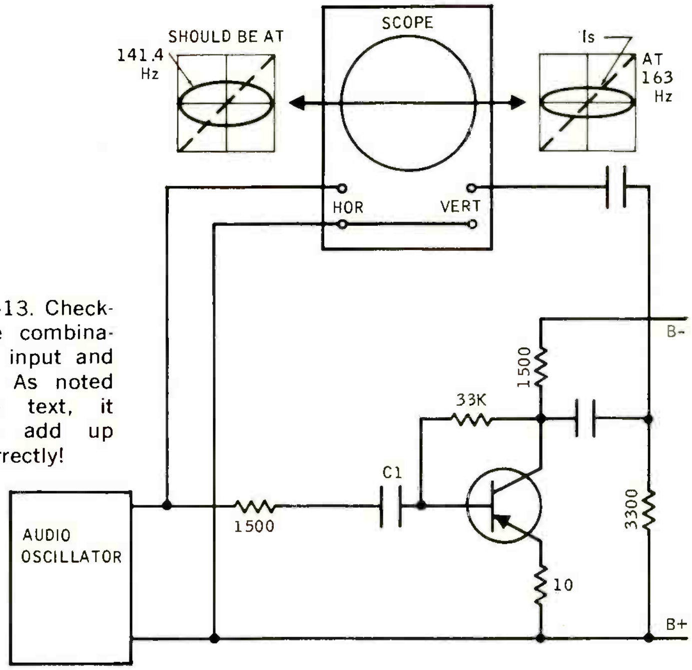


Fig. 16-13. Checking the combination of input and output. As noted in the text, it doesn't add up correctly!

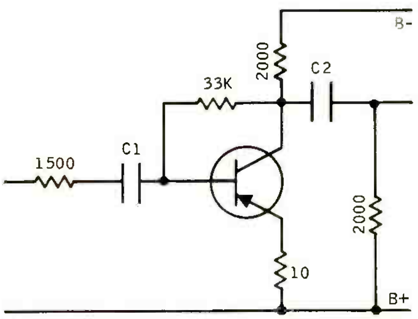


Fig. 16-14. Change in circuit values, to allow more feedback, to try and adapt the results of Fig. 16-13 so the circuit can still be used.

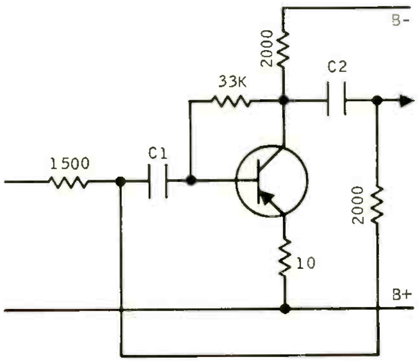


Fig. 16-15. Connecting the feedback for the next check.

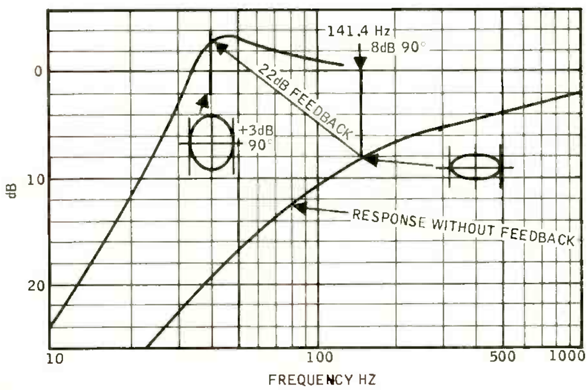


Fig. 16-16. This is the change that feedback should produce. As explained in the text, it doesn't.

Alternatives

We have choices now. We could add an emitter follower to eliminate the interaction (*Fig.* 16-17) in which case we will probably need another emitter follower for isolating or impedance changing, before we're through. Or we could use three stages to get the correct feedback phase relationship (instead on one stage), with the gain clamped down much more, so the interaction is eliminated in this way.

The latter method looks best, because the stages are being put to better use than working one stage for all the voltage gain and then adding emitter followers merely as current amplifiers. We decide to use stages whose gains are adjusted, respectively, to 10, 10, and 3 (*Fig.* 16-18). To get these gains precisely, the values are calculated from voltages and currents and relative signal levels as follows:

For the output stage, with the same a.c. through 330 ohms in the collector and 100 ohms in the emitter, the voltage gain will be about 3 at the collector and 1 at the emitter. The feedback resistor will shunt the 330-ohm load with about 10 times that value, bringing the total load to about 300 ohms.

If we drop 1.5 volts in the emitter resistor, we will drop 5 volts in the collector resistor, giving 7 volts at the collector. Output stage current will be 15 mA. The peak-handling ability will be about 4 volts at the collector and 1.33 volts at the emitter, which is slightly less than 1 volt rms.

To bias this stage, we plan on 3300 ohms from base to ground. With 1.5 volts, this will pass 450 μA. Base current will be about 1/100 of 15 mA, or 150 μA, so the resistor from supply negative to base will take 600 μA at 10.5 volts, requiring a value of 18k ohms (nearest preferred value).

As load for the preceding stage, this base presents 100 times the emitter resistor, or 10k ohms, in parallel with 3300 and 18k, which figures to about 2200 ohms. Putting a 100-ohm resistor in the emitter of the middle stage, its collector resistor must be 1800 ohms, so that paralleling with 2200 ohms finishes up at 1000 ohms.

Now we set middle-stage collector voltage at 3, which means the 1800-ohm resistor has 9 volts across it, and passes 5 mA, producing 0.5 volt at the emitter, across the 100-ohm resistor. Again using a 3300-ohm resistor from base to ground, its current will be 150 μA. The base current, 1/100 of 5 mA, or 50 μA, requires the resistor from supply negative to base to pass 200 μA (150 + 50) with a drop of 11.5 volts, a value of 56k ohms.

As load for the first stage, 10k-ohm base input, in parallel with 3300 and 56k makes about 2400 ohms. So the first-stage collector can use a 1800-ohm resistor and the resulting collector impedance will be a little more than 1000 ohms.

The output stage delivers 1.33 volts peak at the emitter and requires approximately the same base input. With 3 volts on its collector, the middle

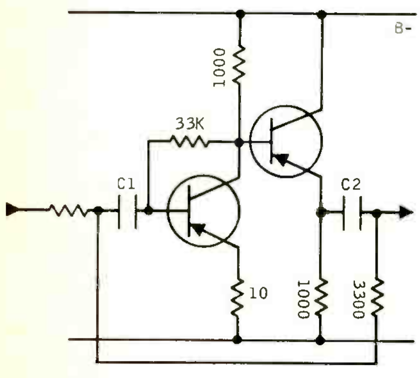


Fig. 16-17. One solution: the addition of a direct-coupled emitter follower. The emitter of the second stage follows the collector voltage of the first and changes the source impedance by the gain of the stage. This does enable the feedback change shown at Fig. 16-16 (or even with only 18 dB feedback) to be achieved.

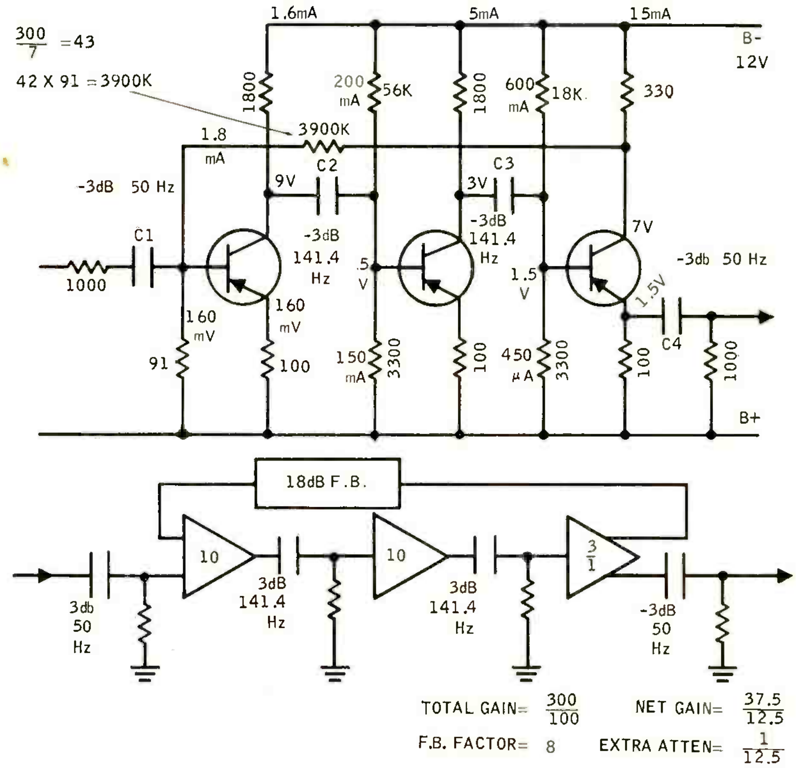
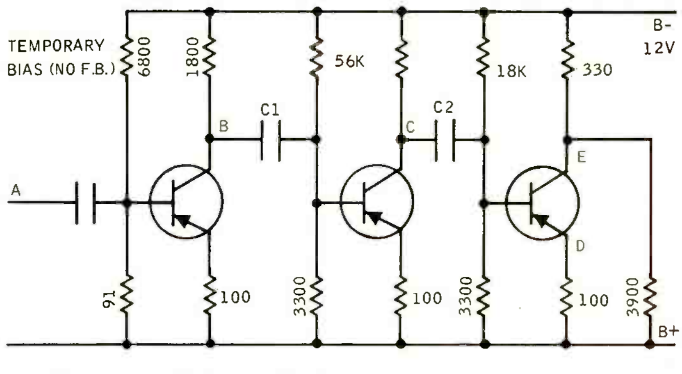


Fig. 16-18. The circuit finally used, with the calculated values. Text explains method of calculating. Measurements confirm calculations at each step.



Test	Hor.	Vert.	Check
1	A	B	Gain ≅ 20 dB
2	B	C	Gain ≅ 20 dB
3	C	D	Gain ≅ 0 dB
4	C	E	Gain ≅ 10.4 dB
5	A	C	Response of C1, —3 dB at 141.4 Hz.
6	B	E	Response of C2, —3 dB at 141.4 Hz.
7	A	D	Response of C1 and C2, —6 at 141.4 Hz.

Fig. 16-19. Checks of gain and rolloffs within feedback network.

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stage will deliver 1.33 volts peak easily, requiring 133 mV at its base. The first stage will require 13.3 mV input.

Now let's figure the feedback. The total voltage gain, from base input of the first stage to the last-stage collector, is 300. To the emitter it is 100. The feedback must reduce gain by a factor of 8, so the respective gains will be 37.5 and 12.5, after feedback is added. To come out at unity gain, we need an attenuation of 12.5:1. If an input resistor (including any source impedance, if there is any) of 1000 ohms is used, and the output feeds a 1000-ohm resistor (including output load, if used), the 1000-ohm input must feed into a resistor of 1000 ohms divided by 11.5, or 87 ohms. The base-input resistance is about 10k again, so a 91-ohm resistor should provide a slight margin of gain.

Now for the feedback: the forward voltage gain is 300; the fed-back portion must be 7 times input, so the attenuation must be 300/7 = 43. The series resistor needs to be 42 times 91, or about 3900 ohms. This will feed back the correct portion, load down the collector so the last-stage gain is about 3, and provide a bias for the first stage, which we should now check.

The collector voltage of 7 will feed about 1.8 mA into the 3900-ohm resistor, producing about 160 mV bias for the base, which will transfer to the emitter by follower action. The first-stage current is thus controlled to 1.6 mA. Flowing through the 1800-ohm collector resistance, this drops 2.9 volts (say 3) giving a collector voltage of 9, which should be satisfactory.

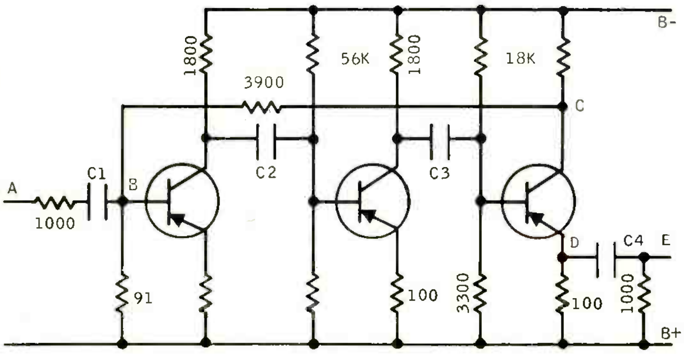
Now set the circuit up for checking (*Fig.* 16-19). Check each stage gain and try different samples of the transistor type used. Couple them with capacitors and adjust to get the correct rolloffs. The response of each coupling should be checked individually, but it can be *in situ*, because the extent to which the gain is clamped down eliminates interaction, except for the impedance values already discussed.

Finally the input and output rolloffs are added and adjusted (*Fig.* 16-20) and the feedback adjusted, if necessary, to get the inside two couplings to produce +3 dB, 90 deg. at 50 Hz. The over-all response adjusts fairly readily, taken a step at a time, to the ideal response needed (*Fig.* 16-21).

If some other impedance is needed (than 1000 ohms input and output), the circuit can be revised by changing the input and output resistors and the associated coupling capacitors. Also emitter followers could be added, if the over-all response needs to be made independent of precise terminating impedance (which it would not be, as shown). We have used this procedure to develop a filter and show the testing procedure needed to get the correct result.

We should stress that careful working out of the details we have shown can save a lot of time. It is much easier to arrive at correct values by careful calculation than by cut and try, using measurements only. On the other hand, don't trust your calculations without making measurements to confirm them. There may be some concealed impedances or effects that you don't consider, and they can make your calculations fail completely. Measurements and calculations should go hand in hand.

Next month, we will discuss some other measurements where checking what is really happening can help solve some puzzling problems, or answer some questions. Æ



Test	Hor.	Vert.	Check
1	A	B	Response of C1, —3 dB at 50 Hz.
2	D	E	Response of C4, —3 dB at 50 Hz.
3	A	C or D	C1 bypassed with 50μ F, +3 dB at 50 Hz.

Fig. 16-20. Checks of input and output rolloffs and combined effect within the feedback network with feedback applied.

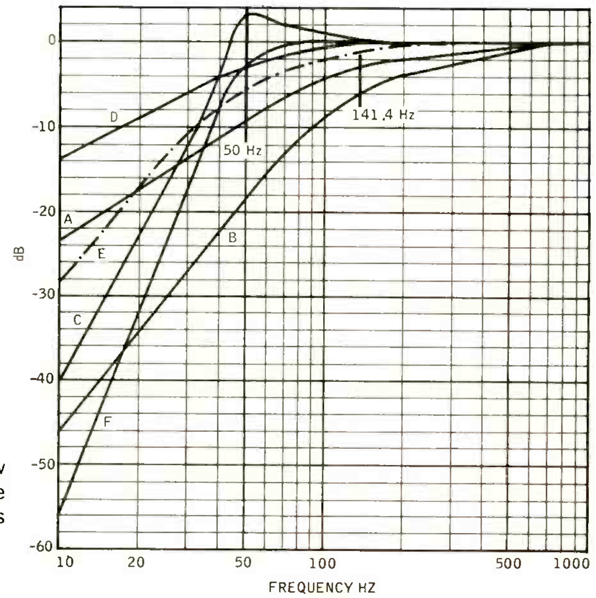


Fig. 16-21. How the final response is built up in this filter design.

A. Response of C2 or C3, —3 dB 45° at 141.4 Hz.
B. Response of C2 or C3, —6 dB 90° without feedback at 141.4 Hz.
C. Response of C2 and C3, +3 dB 90° with 18 dB of feedback at 50 Hz.
D. Response of C1 or C4, —3 dB 45° at 50 Hz.
E. (Dashed) C1 and C4.
F. The whole combination, —3 dB 180° at 50 Hz.

REFERENCES

1. AUDIO, October, 1954, "Feedback Channel Separators" by Norman Crowhurst.
2 AUDIO, Sept., 1957, "Equalizer Design" by Norman Crowhurst.
3. AUDIO, Sept., 1960, "Electronic Crossover Design" by Norman Crowhurst.

New Products

Automatic Turntable

United Audio Products adds a new automatic turntable to its line, the Model 1015. Priced as low as $89, it shares many features with the Company's top-of-the-line $129.50 Model 1019, including a dynamically balanced tonearm, direct-dial anti-skating, and a cueing system that can be used for manual or automatic play functions. The cueing system also permits damped cueing action to be used with automatic start. Tracking as low as ½ gram, the 1015 can accommo-

date the latest generation of high compliance cartridges. Both tracking force and anti-skating force are applied by direct-reading numerical dials, each calibrated to the other. Tracking force dialing accuracy is said to be within 0.1 gram. Adjustable stylus overhang and a pause position on the tonearm resting post add further to the versatility of the Dual 1015. Motor speed is said to be constant within 0.1% with a voltage variance of ±10%. Turntable platter weight is 4 pounds. Check 4

Six-Transducer Speaker System

The Rectilinear II speaker system has a frequency response of 22 to 18,500 Hz ± 4 dB, according to its manufacturer. Six speakers are employed to achieve this linear response. They're bonded to the front panel with an epoxy resin. The

low-frequency speaker, with a 10-pound magnet structure, achieves a fundamental frequency of 20 Hz in its own enclosure. The mid-range driver, which is encapsulated in a non-resonant fibre chamber, has a secondary dispersion cone for effective dispersion of middle-frequency signals. Four high-frequency drivers, two tweeters, and two super tweeters, account for its upper-range performance to 18,500 Hz. Crossover points are 250 Hz, 3000 Hz, and 11,000 Hz. Dimensions of the hand-rubbed walnut enclosure are: 35″ high × 18″ wide × 12″ deep. $269.00. A shelf-model version (pictured), called the Rectilinear VI, at $249, contains the identical components with the exception of the woofer, which is smaller. The bottom frequency of the "VI" is 26 Hz compared to the larger "II's" 22 Hz. The shelf-model's enclosure measures 14″ high × 25″ wide × 11⅜″ deep. Check 5

Receiver-Turntable "Compact"

Harmon-Kardon introduces an integrated FM stereo-AM receiver/record changer "compact," the Model SC6. The new combination incorporates a BSR record changer which is equipped with an Empire 8C8 magnetic cartridge. Among

its many features are a front-panel stereo headphone jack, tuning meter for AM and FM, tape recorder record and playback facilities, contour switch, and automatic switching to FM multiplex when it is received. A lucite dust cover is optional. The unit is not available with speakers, which may be purchased as separate components or used with the purchaser's existing speakers. List price is $329.50. Check 6

Audio Oscillator

One of the prime tools needed by the serious experimenter is an accurate and low-distortion audio generator. Such is the case with this Hewlett Packard 652A test oscillator. Resolution of 0.25 per cent is available over the entire range of 10 Hz to 10 MHz. The output meter indications may be expanded twenty times so that extremely accurate voltage settings may be achieved. Thus very accurate wideband measurements may be rapidly made. Circuitry is all solid-state and is the same resistance-capacitance type as in the familiar HP 651B. It shares that unit's amplitude stability of 10 parts per million per minute in ordinary environ-

ments. There are two outputs. One delivers up to 3.16 volts into 50 ohms; the other will deliver the same voltage into 600 ohms. An adequate output attenuator is included. The model 652A is $726. Check 7

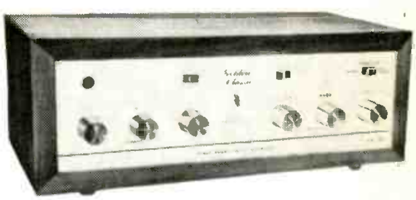
Organ Kit

Schober Organ has just announced a new theater-type organ to be sold in kit form. Schober states that there are no special skills necessary to build this, nor any of their kits. Printed circuits are used throughout to reduce greatly the amount of time necessary and to assure that the self-assembled organ will match the original design parameters. The new model features a 25-note pedalboard and a pair of full 61-note keyboards. There are 48 stop tablets and the pitch regis-

trations available range from one to sixteen feet. All circuitry is fully transistorized. Additional features include 35 speaking stops and 4 couplers. These cover the full range of true-theater-pipe-organ sound. In addition there is an optional combination action and an 8-voice percussion section available. Included are such voices as orchestra bells, harpsichord, mandolin, and piano. List price of the total kit is $1350.00, though the entire assembly need not be purchased at once. Check 8

Low-Cost Amplifier

Olson Electronics has just announced the model AM-300. This is a 35 watt solid-state stereo amplifier in a walnut-finished



cabinet. Separate bass, treble, and volume controls are furnished for each channel. Inputs are available for one high-level and one magnetic-phono or ceramic input. Separate switches select mono or stereo mode and power ON/OFF. A pilot light is provided. Specifications include frequency response of 40-20,000 Hz; power output of 17.5 watts per channel; and 12⅜ x 4¾ x 7 in. deep dimension. List price is $54.98. Check 9

Get to know the dB better

How to become a mathematical expert—at least as far as calculations involving decibles are concerned—simply by learning a few principles and memorizing some tables. If that seems too difficult, you have have to learn how to operate with logarithms.

GEORGE H. R. O'DONNELL

AND DOING IT MENTALLY, only: no pencil, no paper, no formulas (like dB = 10 $\log_{10} P_2/P_1$; dB = 20 $\log_{10} E_2/E_1$; dB = 20 $\log_{10} I_2/I_1$; no Table of Common Logarithms; and no slide rule. Just you—and the printed page. Yes, here are suggestions for 'working' dB's with approximate, and definitely practical, accuracy. And, it's all easy to understand—and remember.

To convert given dB's into their equivalent power (gain) ratio, apply

RULE I: Raise '2' to that power found by dividing the given dB's by '3'. Some examples:

Given dB's	Our way	Standard Way
6 dB $= 2^{6/3} = 2^2 = 2 \times 2$	4x	3.981x
9 dB $= 2^{9/3} = 2^3 = 2 \times 2 \times 2$	8x	7.943x
12 dB $= 2^{12/3} = 2^4 = 2 \times 2 \times 2 \times 2$	16x	15.85x
15 dB $= 2^{15/3} = 2^5 = 2 \times 2 \times 2 \times 2 \times 2$	32x	31.62x

RULE II: Whenever such a division by '3' has a ⅓ or a ⅔ left over, ignore the correct mathematical (exponential) way to resolve that, and merely increase the ratio thus far found by ⅓, or by ⅔, more (ignoring any further fraction this last dividion might have:

7 dB $= 2^{7/3} = 2^{2\frac{1}{3}} = 2 \times 2 = 4+$

⅓ of 4 = 1⅓ (Ignore this last ⅓, and add:)

= 4 + 1 = 5. Therefore, 7 dB = 5x. (Standard is 5.012)

8 dB $= 2^{8/3} = 2^{2\frac{2}{3}} = 2 \times 2 = 4+$

⅔ of 4 = 8/3 = 2⅔ (Ignore even this big ⅔)

= 4 + 2 = 6. Therefore, 8 dB = 6x (Standard is 6.310)

10 dB $= 2^{10/3} = 2^{3\frac{1}{3}} = 2 \times 2 \times 2 = 8+$

⅓ of 8 = 2⅔ (Ignore the ⅔)

= 8 + 2 = 10. Therefore 10 dB = 10x. (Standard is 10.000)

RULE III: Since the heart of this procedure lies in your capability of counting rapidly and easily *up* the powers of '2' (that is, by continuously doubling the preceding number—after beginning with '2'), learn to do it by practicing the 'runs' below—but, in doing so, always change any '128' that so appears, instantly into a '125', and then continue doubling:

TABLE I

$2 = 2^1$	$32 = 2^6$	$1{,}000 = 2^{11}$	$32{,}000 = 2^{16}$	$1{,}000{,}000 = 2^{21}$
$4 = 2^2$	$64 = 2^7$	$2{,}000 = 2^{12}$	$64{,}000 = 2^{17}$	$2{,}000{,}000 = 2^{22}$
$8 = 2^3$	$125 = 2^8$	$4{,}000 = 2^{13}$	$125{,}000 = 2^{18}$	$4{,}000{,}000 = 2^{23}$
$16 = 2^4$	$250 = 2^9$	$8{,}000 = 2^{14}$	$250{,}000 = 2^{19}$	$8{,}000{,}000 = 2^{24}$
$32 = 2^5$	$500 = 2^{10}$	$16{,}000 = 2^{15}$	$500{,}000 = 2^{20}$	

RULE IV: To convert given dB's into their equivalent *voltage* or *current* gain ratios, take the *square root* of the corresponding *power* gain ratio:

TABLE II

dB's	OUR Power gain ratio	OUR E-or-I gain ratio	STANDARD E-or-I gain ratio
6 dB	4×	2.0×	1.995
7 dB	5×	2.2×	2.239
8 dB	6×	2.5×	2.512
9 dB	8×	2.8×	2.818
10 dB	10×	3.2×	3.162
11 dB	13×	3.6×	3.549
12 dB	16×	4.0×	3.981
13 dB	21×	4.5×	4.467
14 dB	26×	5.0×	5.012
15 dB	32×	5.6×	5.623

Before reversing our procedure, that is, before going from ratios back to dB's, it is worth our while very much to memorize the following three columns:

TABLE III

Decibels	Power Ratios	Voltage or Current Ratios
0	0	0
1	1.3	1.1
2	1.6	1.3
3	2.0	1.4
4	2.5	1.6
5	3.2	1.8
6	4.0	2.0
7	5.0	2.2
8	6.3	2.5
9	8.0	2.8
9.5	9.0	3 0
10.0	10.0	3.2

To permit of easier memorization; these three columns use values that are simplified, and yet which are close enough to the "standardly" accurate values, to permit utilizing any decibel relationships with very practical accuracies. Also—excepting the second column—these values are easy to memorize, vertically and horizontally. The first column is practically just counting; the third column presents the square roots of the values in column 2, and can be done mentally. When you have mastered the groups, a glance tells you at once that a change of one-tenth more ($1.1\times$) in voltage (or current) produces the very same change in dB produced by an increase of a third ($1.3\times$) in the power (wattage): both are a change of 1 dB. And so on, with all the rest.—But, even more important perhaps; those three columns can be used to establish the rate of change between every vertically ADJACENT pair of numbers in the following table—which is also to be memorized:

TABLE IV

Equivalent dB's	*Power gain ratios*	*Voltage or current gain ratios*
10	10	3.162*
20	100	10
30	1,000	31.62
40	10,000	100
50	100,000	316.2
60	1,000,000	1,000
70	10,000,000	3,162
80	100,000,000	10,000
90	1,000,000,000	31,620
100	10,000,000,000	100,000

*The square root of 10 is 3.162 (Rule IV).

At one glance, Table IV shows us why we use dB's at all: To get away from use of numbers so large that they don't mean much of anything, except to convey a sense of incomprehensible hugeness. So, physicists thought that smaller units in (logarithmic) dB's might seem more manageable.—And yet, ARE they?—Except for an extremely restricted few, how many scientists and engineers—let alone 'audio' folk (outside of the few professional designers), and the multitudinous electronic technicians all over the electronics world—are really willing to figure out, mentally and with practical accuracy, just what the practical values of the power (W) or the E or I gain ratios are, or what the dB's represent in such values?—Few! And those who do know how, just don't bother (even when they'd like at times very much to know) to do it: "Too much trouble!" (So, in effect, they 'get along' also, by not knowing either! Hence the motivation for doing this paper.)

Given *any number* in the 'power' column in Table IV, the corresponding dB's are found easily:

RULE V: Count the number of zeros in the second column above, and multiply them by '10', and that's the number of dB's it represents (see the first column for confirmation of the rule): for example, '1000' contains three zeros; then, $3 \times 10 = 30$, therefore a change of $1000\times$ in power is a change of 30 dB; similarly, a change of $100\times$ in power, is $(2 \times 10 =)\ 20$, that is a change of 20 dB.

Given any number in the voltage or current column above, the corresponding dB's are found by

RULE VI: Square the number for the voltage (or current) gain-ratio change, and then apply Rule V. For example, take a current ratio of 31.62 (1 mA increases to 31.62 mA) square that ($31.62 \times 31.62 = 1000$), and then apply Rule V, that is, count the zeros (or rather the digits present less one—up to the decimal point), and multiply them by '10'—result: a change from 1 milliampere to 31.62 milliamperes represents a change of 30 dB.

Before we are ready to apply Rules V and VI to ANY gain ratio (for instance, a gain ratio BETWEEN any of those VERTICALLY ADJACENT to one another in Table IV (such as a gain ratio lying between 10 and 100, or between 100 and 1000), we should learn to apply

RULE VII: To ADD any two dB's, you must—to get the resulting GAIN RATIO—MULTIPLY the gain ratios of the two dB's you add, thus:

$3\text{ dB} = 2\times\ (W)$ or $1.4\times\ (E \text{ or } I)$
$\underline{6\text{ dB}} = 4\times\ (W)$ or $2.0\times\ (E \text{ or } I)$
$9\text{ dB} = (2\times) \times (4\times) = \underline{8\times\ (W)}$, or
$= (1.4\times) \times (2.0\times) = \underline{2.8\times\ (E\text{ or }I)}$

For confirmation, see '9' in the first column of Table III, and then note the values beside it. Now, practice such additions, using the values in the three columns, plus those under Rule IV. You'll have all sorts of use for this rule, and be learning much about how to handle decibels!

Now we are ready to tackle ANY *gain ratio* not already included in Table IV. Assume the number '25' (between '10' and '100' in the power-gain ratio column — representing a change of $25\times$ in power between the input and the output of an amplifier; what's the change in decibels?

RULE VIII: Pick out, in the proper gain-ratio column, the pair of vertically adjacent numbers, *between* which the gain ratio of interest falls; next, in the second column of Table III, pick out the same (W, or E-or-I) gain ratio which, when multiplied by *the lower value* of the two vertically adjacent numbers, will give a number equal to, or *under*, the gain ratio of interest (here, '25'); then that will be the whole-number value of dB's closest to the proper dB ratio.

For instance, the power-gain ratio is '25' which falls between '10' and '100'; so, divide the power-gain ratio (25) by the lower of the two vertically adjacent numbers of Table IV, (10), which gives 2.5; then locate '2.5' in the Power-Ratio column of Table III, and note its dB value, which is '4'. Then add this dB value to that of the lower of the two vertically adjacent power-gain ratios in Table III, which is '10', giving a total of 14 dB. Confirm it by looking at '14 dB' in Table II; for practical purposes, this is quite close enough.

NOTE: Of course if you want to come closer, than the nearest WHOLE-number value in dB's, you had better learn to use the formulas—which is what we have really been leading up to all the time. Here's how:

Using the Formulas

Assume an amplifier accepts an input of 0.3 watt, and puts out 106 watts. What is the gain in dB?

$$\text{dB} = 10 \log_{10}\frac{P\text{ out}}{P\text{ in}}$$
$$\frac{P\text{ out}}{P\text{ in}} = \frac{106}{0.3} = 353.3$$
$$\log_{10} 353.3 = 2.5482$$
$$= 10 \times 2.5482 = 25.48$$
$$= 25.48\text{ dB}$$

But, where did the '2.5482' come from? From a Table of Common Logarithms, for all of it AFTER the decimal point: just look up '35' at the left side of the table, and '3' at the top; run down from the '3' at the top, level with the '35' on the side, and copy off the four numerals there.—But, *from where* the '2' in front of the decimal?—Look in Table IV: '353.3' falls be-these two, there is but *one* zero.—'1000'. The lower of the two values has how many zeros?—That's where the '2' comes from!

Take another example: assume that the same amplifier shows an input of 0.5 volt, but an output of 9.4 volts. What's the gain in dB?

$$\text{dB} = 20 \log_{10}\frac{E\text{ out}}{E\text{ in}}$$
$$\frac{E\text{ out}}{E\text{ in}} = \frac{9.4}{0.5} = 18.8$$
$$\log_{10} 18.8 = 1.2742$$
$$= 20 \times 1.2742 = 25.48$$
$$= 25.48\text{ dB}$$

Why did we put a '1' in front this time?—Because '18.8' lies between '10' and '100'; and in the lower value of these two, there is but *one zero*.—And now, review all this. If you remember of it only the first two rules, that alone was well worth your time in reading this whole article. Æ

Equipment Profiles

PIONEER SX-1000 TA STEREO RECEIVER

Pioneer has not been in the forefront of the rush to transistors. Their earlier receiver, still in the catalogs and reported upon in December, 1966, was an all-tube unit. Now comes their top-of-the-line receiver designed as an *almost* all-transistor unit. The FM front end has three tubes, a 6HA5 and two 6CW4 nuvistors. Behind this there are 45 transistors, 37 diodes (including one zener in the low-voltage portion of the power supply), and two thermistors. Our tests, both in the listening and on the test bench, have shown this unit to be a product of that which is best in both tube and transistor technologies.

The SX-1000TA is reasonably compact, measuring 16 in. x $5\frac{7}{16}$ in. x $13\frac{13}{16}$ in. deep. Weight is 25 lbs. Both height and weight are increased slightly with the unit in the walnut cabinet that is included in the basic price. The receiver mounted in this case is undeniably handsome, a feature that is important in today's marketplace.

The receiver is well-endowed with features, another plus factor. That they also add to the enjoyment of this instrument must be added that there is no useless gadgetry. From left to right then: an on/off power switch; earphone jack; concentric knob but unganged dual bass control; low filter; high filter; treble control (operating as does the bass); balance control; muting; afc; loudness comp; volume; phono 1 or phono 2; mode. Above and to the right are the tuning knob and the selector—AM, FM mono; FM auto; phono; 3¾ tape head; 7½ tape head; aux.

Tuning is aided by a signal-strength meter and stereo FM identification by an indicator light.

This is a sweet performer, well able to provide the critical listener with all he wants to hear. It handles easily. We particularly liked the slow-acting volume control that did not blast when it was cracked open. We were surprised to find that Pioneer stands virtually alone in providing a defeatable loudness, compensation that boosts both bass *and treble* in low-level listening. The action of the front-panel switches is positive. These are no super-miniature difficult-to-grasp controls. The switches are flat ended and are *off* in their upright position. Simply depress them and they are *on*. The rotary switches are firm, yet easy to turn.

The rear apron presents an impressive set of connections. There is a total of three phono inputs. With the front panel switch in phono-1 position you can feed in a magnetic *or* ceramic input. In the phono-2 position you can use a second magnetic phono. Then there is a separate tape-head position. The rest of the positions are used by the tape monitor in and out, aux, and a DIN (German standard) record/play input socket for a tape recorder.

The speaker connectors are unusual in that they are removable from the unit. You connect to two screw-type connectors with a fat separator to prevent accidental shorting. These can be pulled out and switched back and forth at will. A good thing, we think. The rear panel also contains two a.c. receptacles; one is switch controlled. A slide switch may be set to change the power transformer connections for operation from 120 or 230 volts.

Up above are the three screws for antenna connection. Two represent a 300-ohm FM input, the third is for AM. There is also a swingable and tiltable ferrite loopstick.

Test Results

The FM portion of the receiver has an IHF sensitivity of 2.5 μV. A listenable 50-dB signal-to-noise ratio is reached at about 12 μV levels. This represents a sharp sensitivity curve that makes for a higher *usable* sensitivity than the figures would tend to indicate. The optimum signal-to-noise ratio in FM is 58 dB. FM frequency response is flat from 22 Hz to 10 kHz. Above that frequency response begins to droop to a −3 dB point at 15 kHz.

Channel separation in stereo is excellent, ranging in excess of 30 dB in the critical mid-range and treble areas. At 400 Hz, the usual measuring point, separation was 35 dB.

The power amplification is first-rate. All measurements were made with both channels operating. *Figure* 1 shows the power response with 0 dB equalling 40 watts per channel. This represents an 8-ohm load. At 4 ohms, maximum power is 50 watts at the midband, while at 16 ohms power reduces to 25 watts per channel. Power bandwidth is 15 to 40.000 Hz.

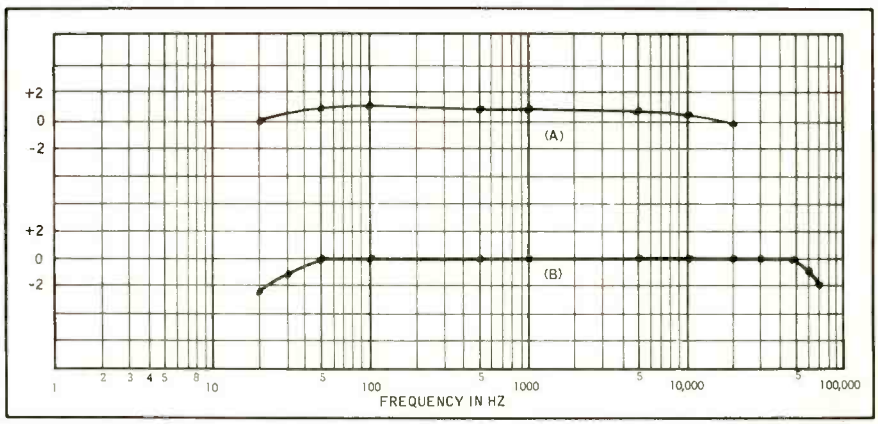


Fig. 1. (A) Power response curve of the Pioneer SX-1000TA receiver. 0 dB = 40 W/channel. (B) Frequency response at 1-W output.

not all cardioid microphones are alike . . .

the

SHURE UNIDYNE® III

TRUE CARDIOID UNIDIRECTIONAL DYNAMIC MICROPHONE SOLVES ALL THESE COMMON MICROPHONE PROBLEMS!

PROBLEMS CAUSED BY INEFFICIENT REJECTION OF UNWANTED SOUNDS BY THE MICROPHONE

SITUATION	PROBLEM	CAUSES	SOLUTION
REFLECTIONS	Feedback occurs where a so-called "cardioid" microphone is used and the speakers are placed to the rear of the microphone. A common occurrence in churches, auditoriums, and meeting rooms.	Sound bounces off hard surfaces on the walls, floor and ceiling, in and around the audience area and the microphone used is not effective in rejecting these sounds at all frequencies, and in all planes about its axis.	The Unidyne III rejects sound at the rear with uniformity at all frequencies. Sounds bouncing off floor or other surfaces are uniformly rejected.
COLUMN LOUDSPEAKERS	Unexplained feedback. Column loudspeakers are used to distribute sound more evenly to the audience in churches and auditoriums.	Feedback occurs when rear and side sound lobes of column speakers coincide with rear and side lobes of so-called "cardioid" microphones.	The Unidyne III solves this problem because it has no rear or side lobes. Thus it rejects the side and rear lobes of the sound column speakers.
REVERBERANT BOOM!	A disturbing, echoing effect of low frequency sound often found in churches, large auditoriums, and arenas.	Low frequency reverberation and boominess occuring when microphone fails to retain unidirectional characteristics at low frequencies.	The Unidyne III maintains a uniform pattern of sound rejection at all frequencies, even as low as 70 cps. The response has a controlled roll-off of the low end—low frequency reverberation diminishes effect of boomy hall.

PROBLEMS CAUSED BY THE MICROPHONE'S INEFFECTIVENESS IN PICKING UP THE DESIRED SOUND

SITUATION	PROBLEM	CAUSES	SOLUTION
GROUP COVERAGE WITH ONE MICROPHONE	A single microphone does not provide uniform coverage of a group. This is commonly experienced with choral groups, quartettes, instrumental combos, and speaker panels.	The particular "cardioid" microphone used lacks a uniform pickup pattern, so that persons in different positions within the general pickup area of the microphone are heard with varying tonal quality and volume.	The Unidyne III affords uniform pickup of the group with a resulting consistency in volume and sound quality among the members of the group.
USING MULTIPLE MICROPHONES	Variation in the pickup level and tonal quality exists throughout the broad area to be covered. This may occur in stage pickup of musical and dramatic productions, panels and audience participation events.	The pickup pattern of the microphones used is too narrow, causing "holes" and "hot spots." The off-axis frequency response of the microphones also varies.	The Unidyne III permits smoothness in pickup as true cardioid pattern gives broad coverage with uniformity throughout coverage area. Eliminates "holes," "hot spots," and variations in sound quality, simplifies blending many microphones.
DISTANT PICKUP	Too much background noise or feedback results when working with microphone at desired distance from sound source.	Long-range microphones are less directional with lower frequencies. Lobes or hot spots allow background noise or feedback.	Use the Unidyne III to gain relatively long range with effective rejection of sound at all frequencies at the rear of the microphone.

SHURE BROTHERS, INC., 222 HARTREY AVE., EVANSTON, ILL. 60204

Check No. 117 on Reader Service Card.

Amplifier frequency response is also shown in *Fig.* 1. This represents a rise time of 4 μsec. and is certainly wideband. IM distortion is at lowest level at low power, being on the order of 0.5 per cent. It rises to just over 2 per cent at 40 watts, again with both channels being driven simultaneously. Harmonic distortion measured 0.5 per cent at rated output, 1000 Hz.

The mag-phono inputs each have a sensitivity of 3.4 mV for full output and overload begins to become evident at 70 mV.

The front panel mode switch selects stereo operation or it will feed either a left or right channel input out to both amplifiers. There is no A + B position. This, we feel, is a minor shortcoming, at least for those with existing mono collections. It is not that you cannot play mono records, rather that, lacking the A + B's vertical cancellation effect, there will be more noise and distortion than is ideal. Of course, stereo records played in the stereo mode are unaffected.

While there is a dearth of decent programming on AM radio, some areas must have this equipment if they are to hear anything at all. The Pioneer does have a fine AM tuner. Though not specifically tested, we judge it to be as good as will be required from this transmission system.

In the end it gets back to the listening. And that is where this Pioneer shines. It produces smooth, easy-to-take sound that can be lived with nicely.

One can never exclude price in the consideration of a product. So when you realize that this receiver is only $360 including the walnut cabinet, you must come to the same conclusion we have. Namely, that Pioneer has themselves an exceptionally fine product here, which at IHF 4-ohm rating could be classified as a 110- or 120-watter. If you are contemplating a stereo receiver (and most people are these days) this Pioneer SX-1000TA should be high on your must-see list. Check 12

PIONEER PL-41 INTEGRATED TURNTABLE

The battle between manual and automatic turntables is likely to go on forever. These days it would seem that the two have come so close that it is no no longer possible to distinguish between them in performance.

So what justification is there to buy a manual turntable if a changer can perform as well?

Well, the simple facts are that while there are changers that are the equal of the better manuals (and in fact, are superior to manuals of a few years ago), the makers of manuals have not simply been sitting on their hands. After all, engineering is on the side of the simpler product and a manual has much less to do than a changer.

The net result of all this is that the best of the newer manual tables can perform better than the best of the automatic units.

That word "better" is perhaps misleading. The improvement possibilities left to manual or automatic turntable designers are not so great that differences between products is as night and day. A recent inquiry at our office complained that a certain high-quality turntable had some audible rumble. The fact is that there is no turntable, given high-volume stereo performance, that is totally rumble free. But rumble should be low enough so that it is not objectionable. (And remember we are talking about reproduction rumble—there are all too many records that have recorded-on rumble of their own.)

Which brings us to this Pioneer unit. This is an integrated unit, is supplied with a built-on arm. As can be seen from the illustration, the unit is furnished on a handsome walnut base and supplied with a sturdy plastic hinged-on dust cover. Certainly, it makes an attractive package; at least so our distaff side thinks.

The turntable is belt-driven from a hysteresis-synchronous motor. Two speeds, 33⅓ and 45, are accomplished by shifting the belt on the motor shaft. This is done conveniently via two push buttons which lever the belt into the proper position. The turntable platter weighs in at just under five pounds and is non-ferrous.

The arm is of static-imbalance design. The rear counterweight is first set to balance the arm, then a vernier adjustment moves the weight forward a calibrated amount to achieve stylus force. There are no springs.

The arm is of simple design. No special attempts have been made to balance it in a lateral plane. The offset cartridge-mounting head (two heads are supplied) has slot motion on the cartridge plate to adjust for proper overhang and minimum tracking error. The head itself can be attached or removed from the arm by a knurled ring of good fit. The insert is of standard dimension and will directly accept Ortofon/SME heads.

The arm uses needle bearings for vertical motion; ball races for lateral movement. An external arm lift is built on to the unit. This operates from the on/off switch. Click stops are provided for *on, off,* and *lower*. Both the arm and arm lift are adjustable for height.

The arm will accommodate a wide variety of cartridge models including the aforementioned Ortofon types. However light-weight cartridges and shells will need some additional weight added at the head because the rear weight cannot go forward far enough. Pioneer does supply extra weights that may be mounted with the cartridge.

We found that the arm also has an inbuilt skating compensation push. It is not clear how this is done, but we would guess that it is accomplished by properly twisting the wires coming from the arm. They are wholly contained within the arm's column. At the bottom there is a plug to which the output cables and ground wire are simply attached.

The rear weight is calibrated in grams and this calibration is accurate. However, as with all such devices we recommend the use of a good gram gauge as a final check of proper stylus force.

Tests and Conclusions

We said at the outset that design anvantages still accrue to the manual system. This was evident in our testing.

Rumble was down 40 dB from a 3.54 cm/sec 1-kHz signal. This is true of vertical plus lateral or lateral alone. Weighting with a 50-Hz rolloff reduced the rumble to —46 dB. Flutter was an extremely low 0.05 per cent at 33⅓ rpm. Speed-accuracy tests indicated that this sample ran just under 1 per cent fast at either speed. Cartridge loads had no effect on speed. Nor did line voltage. Speed was constant from 80-130 volts. This unit

Fig. 2. The Pioneer PL-41 Integrated Turnable.

will run on voltages as low as 30 but it requires at least 75-80 volts to start from a standing stop.

This system has been designed for world-wide use. This is made evident by the fact that motor spindles are supplied for 50 or 60 Hz operation. A panel switch also changes the starting capacitor for the appropriate frequency. A second panel switch (both under the platter) selects 115- or 230-volt operation. It would be wise to check this switch. Our sample was set up for 60 Hz but the switch was in the 230-V position.

The arm bearings are extremely free. Friction is not a significant factor in this arm's performance. Resonance was at 10 Hz; this is low enough to say that it causes no problem.

In fact, problems are something that this Pioneer unit lacks. We feel that it is a splendid performer. Solidly built and beautiful to look at, the PL-41 offers a measure of performance and durability that is suitable for the most fastidious audio buff. Check 13

NORELCO 150 CASSETTE RECORDER

This new wave of compact battery-operated recorders is something. While none of them can be truly called high fidelity, they are surprisingly better than you might expect them to be. Further, they are so delightful to use, and so easy, that they earn the right to appear in these PROFILES. *Figure* 3 shows the complete unit.

The Norelco machines use, of course, the Philips cassette system which was described fully in the May issue. Briefly, it is a reel-to-reel cartridge system using a tape that is roughly half as wide as conventional ¼ in. tape.

The 150 is a two-(half)-track recorder. You play or record one side, then flip over the cassette to complete the tape. The single capstan speed provided on this portable is 1⅞ ips.

All operation is from a single lever. Push up and the 150 plays. Push up while holding down the red button on the side, and the unit records. If you push and hold the lever left or right, the tape will fast-forward or reverse in response.

The 150 is supplied with a dynamic microphone. This is normally carried in a snap-on accessory pouch that attaches to the carrying case. The microphone has two cables and two plugs. One is the microphone signal, the other is the control. Attached to the microphone itself is an on/off switch that allows the user to start or stop the machine remotely. Power is turned off in the remote-control stop-position, but the pressure roller is not retracted from the capstan.

Power is derived from five "C" cells. Their rated life is about twenty hours. This will depend upon the type of battery. We would recommend the kind specifically labelled for transistor radio use.

Considering the tape speed and the fact that this is a battery-drive machine, performance is remarkable. The built-in speaker has little to offer. To say that it is quite good for its miniature size says nothing indeed. It is adequate.

Frequency response is usable (+0, —5 dB) over a 50 to 7000-Hz range. Signal-to-noise was a bit higher than specified; nevertheless it is satisfactorily low: 41 dB below 1 kHz at indicated maximum level.

We should point out that the 150 is equipped with an indicating meter. This tells the condition of the batteries at a glance. In the record mode, it does double duty as a volume indicator. But it is uncalibrated. Instructions merely state that the indicator should not enter the red area of the meter face. This is sufficiently accurate for purposes of speech recording, but makes it difficult to make a meaningful S/N measurement.

(A service manual that is available from Norelco does give the method used for measuring playback sensitivity, and thus S/N. Using this method we did indeed measure the specified —45 dB. However, the figure of —41 dB we believe to be more meaningful under the practical conditions of use.)

Flutter is under an average of 0.25 per cent. While this is detectable on certain types of music, it is entirely satisfactory for a portable unit. Most types of music are played with complete satisfaction. Norelco does have a series of recorded cassettes available under the Philips and Mercury labels; there are also others. These are four-track stereo tapes but can be played on the 150 as compatible mono. The 150's half-track head scans the side-by-side stereo tracks of these tapes.

The tapes themselves contain sufficient tape for 30 minutes of play per side. There is now also available a cassette using thinner tape that will allow 45 minutes of uninterrupted performance per side. Norelco, of course, supplies these cassettes. However, the source for them is not so limited. 3M and others are also offering cassettes.

If you have tapes that are recorded and want to protect them from accidental erasure, Norelco has made the job easy. Simply knock out a plastic cover over an indentation at the rear of the cassette. This prevents a lever in the recorder from being pushed back, so it is not possible to depress the record button. Should you change your mind later on, you can place a piece of transparent tape across the opening, thus reactivating the lever.

Norelco has made a number of useful accessories available for the 150. These include an a.c. adapter that plugs into one of the two special sockets on the side of the machine. It serves to operate the unit, or to recharge the batteries if it is left idle (Although the amount of charge that can be restored to a conventional carbon-zinc battery is certainly debatable.)

Other accessories that go into one or the other of the sockets are a telephone microphone, a foot pedal switch, headphones, and a close talking, noise-cancelling microphone. There is also a car-mount accessory that permits the 150 to play through your car radio on an unused AM radio frequency. *Figure* 4 shows this unit installed.

Standard equipment with the 150 includes the carrying cases, a demonstration tape, the dynamic microphone and removable control switch (this microphone is supplied with an attachable table stand; it also comes with a clip for clothing attachment), and a dual cable that has standard male phono jacks, thus allowing the 150 to connect to conventional equipment for both record and play functions.

Norelco "150" cassette carry-corder

Fig. 4. The optional "Car-Mount" accessory which provides r.f. output to feed any AM car radio on an unused frequency.

This package is $90.00. The particular recorder we have checked has already logged quite a few hours as an electronic memory for interviews we make. We expect to continue using it this way. All that is necessary to capture everything in an average room is to place the mike in a reasonable position and turn the record control up to near full. Clear, clean recordings result.

Plainly, the Norelco 150 serves a special function. But it is a pleasure to report that it does this superbly. Check 14

LEAK "MINI-SANDWICH" LOUDSPEAKER SYSTEM

We have long been skeptical of many claims made for the frequency response of the smallest of the loudspeaker systems, and with good reason, in most instances. We have heard claims for response down to 40 Hz from a speaker system in less than half a cubic foot. With a 40-Hz input signal we heard output, but it was likely to be the result of doubling, and we would call it 120 Hz (which is, of course, tripling). And with outside measurements of 11 x 18½ x 7 in., the inside volume of the Mini-Sandwich can't be over 0.6 cu. ft., and this does not allow for the space occupied by the speaker motors, the crossover network, and the damping material. But in spite of the small size, the Mini does an exceptional job.

The woofer should be called a 7 x 11-in. oval unit, since that is the active area of the cone itself. The cone is made from polystyrene foam "sandwiched" between two layers of aluminum foil. The foam material provides stiffness at about the same weight as a conventional paper cone, and the aluminum foil prevents any air leak through the cone material. Thus the cone is able to act like a piston. Out of the cabinet, the woofer has a very soft suspension, with a long throw, and the cone can be moved easily with the tip of a finger. In the fully sealed cabinet, however, it definitely shows the effect of the loading of the air in the enclosure, and when depressed by a finger, it moves sluggishly. The cabinet sides and back are lined with deadening material which is relatively heavy, and the back is further stiffened by a block of wood which is held between the woofer magnet assembly and the cabinet back by a bolt through it into the speaker. This block, about 2 x 3 x 6 in., also serves to mount the crossover network, which employs two coils and two capacitors.

Fig. 5. Leak "Mini-Sandwich" speaker system

The tweeter is a 3½-in. cone with a magnet 3 in. in diameter and about 2 in. deep—massive for a cone tweeter. It is mounted from the front of the baffle into a cup which keeps back pressure off its cone, and even this cup is deadened by a layer of soft polyethylene foam.

The grille-cloth frame is held to the baffle by six small strips of Velcro—they call it "touch-and-close"—fastening. In any case, the frame with its grille cloth may be removed without tools, and any desired material substituted for the cloth furnished. One feature completely new to us is the instruction for tightening the cloth if it should sag due to excessive pressure—simply hold it in front of a 1-kW electric heater for about a minute. A polarized plug is provided for connecting to the speaker, so that once the proper polarity is determined, the user is assured that he can move the unit and have it correctly phased when it is returned to its place. Furthermore, if connected in accordance with the instructions, one is assured that two speakers connected to a stereo amplifier will be phased correctly when first connected.

Specifications for the "Mini" indicate that it is essentially identical in performance to the larger "Mark II" except for the lowest octave, and in direct side-by-side comparison, this would seem to be the case. On frequency runs, however, there was usable output to over 19,500 Hz at the top end, and output at 50 Hz was down only about 5 dB below the 1000-Hz level. Most importantly, however, was the absence of any peaks in the response from 200 Hz down of more than 2 or 3 dB. This is definitely a small speaker system with which we could live comfortably, even though there was a rolloff in the lower end. Living with the unit for a few weeks indicated that a 4-dB boost at 50 Hz would be adequate to make the system completely satisfactory. Efficiency would be rated at medium, and adequate output for a fair-sized living room could be maintained with a 10-W amplifier. Priced at $135, the Leak "Mini-Sandwich" warrants listening before making a decision.

Check 15

Fig. 6. Shure Microphone Mixer, Model M 68

SHURE M 68 MICROPHONE MIXER

The Shure M 68 Microphone Mixer is a practical and inexpensive solution to the need for mixing the outputs of up to the four microphones. The unit is self-contained, a.c. operated, and provides for mixing four low- or high-impedance mike inputs (in any combination) plus one high-level input. These five inputs can be mixed and fed into the mike input of the recorder, at either high or low impedance, or if more inputs are required, the output of the mixer can be fed into a second M 68, thus accommodating eight microphones and two high-level "aux" inputs. This convenient devices measures $11\frac{3}{8}$ in. wide, $5\frac{1}{4}$ in. deep, and stands $2\frac{3}{4}$ in. high. Along the front are six dial knobs, each marked 1 to 10, an a.c. power switch, and a pilot light. The back mounts five 3-terminal male chassis plugs, five slide switches for selecting the impedance of each. two phono jacks, and an auxiliary 28-volt d.c. accessory output. The input is fed to a single transistor amplifier stage, which in turn feeds the arm of a pot through a mixing resistor. The four mike inputs are identical. The AUX input feeds the arm of the fifth mixer pot through a resistor. All five pots are then fed to another transistor stage, and its output is fed to the master pot. The arm of this pot splits to two circuits—one through a resistor to another transformer which provides for either high- or low-impedance outputs to feed the mike input of the recorder. The other circuit feeds another transistor amplifier stage which provides the "auxiliary high-level output" which is available at a phono jack. This output can be fed into a high-level input of the recorder, if desired. It is seen, therefore, that the device is extremely versatile.

In performance, the maximum low-Z input signal before overload is 50 mV, although at full gain settings of the controls, 1 mV. input will provide a 1-volt output at the high-impedance phono jack. At the high-Z setting, the maximum input signal is 350 mV., and a 60-mV. signal will provide a 1-V. output. Distortion under normal input conditions (below overload) is about 0.3 per cent at a 1-V. output, and remains under 1.0 per cent at 5 V. output. Frequency response is down 3 dB at 10 and 20,000 Hz, and down 1 dB at 50 and 10,000 Hz, which includes the response through the input transformer. One interesting design feature is the arrangement of the mixing pots. The signal is fed to the arm, and the output is taken from the high side. Thus any noise in the pots is isolated by the total resistance of the pot, so that the noise caused by the pot is attenuated as much as the signal, and the S/N remains constant, regardless of the setting of the pots. Measured hum and noise was a satisfactory 70 dB below 1 volt with all pots off, and with the master and one mixer pot full on it was 55 dB below 1 volt. Priced at $75.00, the M 68 is a useful addition to any tape recorder system when several microphones are necessary. Check 16

Tape Guide

HERMAN BURSTEIN

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

Q. In a recent advertisement, a tape manufacturer stated that cheaper tapes in general and "white box" tapes in particular are harmful to recorder heads as they contain little or no lubricant. The ad stated that such tape becomes abrasive, causing pits in the tape heads that trap shedding oxide and form gummy film; and that in the end expensive heads must be replaced and feeding mechanisms repaired. As I have just purchased a new tape machine and have been experimenting with "white box" tape, statements of this sort naturally interest me. What is your feeling?

A. When you buy white box tape you take the risk that it fits the description in the ad you cited. Sometimes, however, it happens to be quite good audio tape or computer tape that will not harm your heads any more than top-quality tape but fails to come up to the manufacturer's quality standards in other respects. At other times it is audio type of tape deliberately made to meet a price, and therefore less considerate of your equipment than are higher-priced tapes.

Q. What is the lubricant employed in tapes, and how large a part does it play in reducing head wear. How important is it to clean the heads and to minimize head wear?

A. To my knowledge the lubricants employed in tape are silicones. The manufacturer's problem is to employ enough lubricant to minimize head wear, but not so much as to cause the tape to slip when grabbed by the capstan and pressure roller. Regular head cleaning should be conducive to head life, although I can't say how much. Keep in mind that the results of head wear will be more apparent in a high-grade audio system than in a low-grade one. Therefore such measures as using properly lubricated tapes and cleaning the heads become more important as system quality goes up.

Q. I am in the process of building a tape recording amplifier that was published in the May, 1963, issue of AUDIO. *Could you please answer some questions concerning this amplifier. (1) How do you balance the bias waveform, by means of R_{20}, a 20-ohm pot, for optimum performance? (2) Am I correct in assuming that R_6, a 25,000-ohm pot, is the playback volume control? (3) Would it be possible to have separate volume controls for the line and mike inputs? (4) Could a microphone with a —55 dB rating drive this amplifier to a sufficient recording level? (5) Why is the input of this amplifier 10,000 ohms, which is between standard 250 ohms and high impedance?*

A. (1) While simultaneously recording and playing with no signal input, adjust R_{20} for minimum noise. (2) The amplifier has no playback volume control. R_6 is in the record amplifier and is an internal gain adjustment so that input and output levels can be equated for A-B comparison. (3) Yes. Replace R_1 (100K ohms series resistor between mike and line inputs) with a 100K pot connected between line input and ground. Connect the arm of this pot through a 100K series resistor to the mike input. Rewire the mike input so that the line input is not automatically disconnected when a plug is inserted into the mike jack. (4) It appears the amplifier has sufficient gain to accept a mike with sensitivity of —55 db/microbar. (5) I don't know. The amplifier seems designed for high-impedance mikes, which characteristically have impedances between 10K and 25K ohms. Chances are that the results of a mismatch between a 25K-ohm mike and the 10K-ohm input impedance of the amplifier will not be serious.

Q. I have two good professional electric guitars but have never been able to get a satisfactory tape recording with either one except in a manner I will explain later. Because of background noise, feedback, and so on, I do not use a mike. The beauty of the electric guitar is its suitability for direct input recording. I have an amplifier of basically good design, and I feed the tape recorder line input from the grid of the phase splitter, after the volume- and tone-control stages. But with either of my guitars I get a distorted recording (indistinct, fuzzy, unclean) regardless of tone- or volume-control settings. It's so frustrating because I get superb recording from FM and records, except for a slight loss of highs inasmuch as I record everything at 3.75 ips and the recorder is rated flat only to 7500 Hz at that speed. I use Scotch 282 sandwich tape, 1½ mil, with plastic coating over the oxide. Other tapes give no improvement from the distortion standpoint. My speakers are big, folded horn units. The guitars sound excellent when played directly through the amplifier and speakers. An electronics engineer friend says that he once looked into the problem of recording stringed instruments having magnetic pickups and discovered that combinations of notes or strings can increase the power output exponentially rather than in a linear manner. If this is true, it obviously spells trouble . . . I have come to the conclusion that high-speed limiting and special equalization are involved in making professional recordings . . . I mentioned earlier that I do have one way to get clean recordings, but the result is not wholly satisfactory as it has too bright or sharp a sound. Both my guitars have bridge pickups. These are not standard magnetic pickups mounted by the bridge but are pickups built into a special wooden bridge. They have a very low output because they only pick up the bridge and sounding board vibrations. But if I use that pickup for the majority of the signal to the tape recorder and mix in a small amount of signal from the standard pickup unit, I get passably clean recording. . . I have a model 510 Fairchild Compander which I have tried to use as a limiter in the compression mode, but with no noticeable success. I guess the limiting response of the Compander is too slow if the guitar is putting out fast-rise-time spikes. I have been guessing that the rise time and/or amplitude of these spikes is responsible for my troubles plus the apparent exponential power output increase for certain combinations of notes or chords. Can you shed some light on this problem?

A. My guess is that the guitar transients (spikes, as you call them) are not only overloading the tape but possibly also overloading the tape recording amplifier, perhaps at an early stage before the recording gain control; and the high signal level may be causing the tape amplifier to block. At an appropriate point *before* the tape recording amplifier, cut down on the guitar signal fed into the tape machine. Record at a level well below that which drives the VU meter of your tape machine to 0 VU. Better yet, try recording on a tape machine which has a magic eye instead of a meter as the record-level indicator, and record at a level that avoids eye closure. If you get clean tape recording only at a level that results in a poor signal-to-noise ratio, you must trade a reduction in dynamic range for an improvement in signal-to-noise ratio. This means the use of a high-quality limiter. Also try recording through a microphone for improved results.

Q. I would like to tape the sound from TV. Is it possible to get just a tuner to provide this sound? Do you know of any one making such a tuner?

A. I have queried several high-fidelity dealers about a tuner capable of bringing in the TV channels, and the answer is that they don't know of such an item available today, although there was one on the market (Bell Sound) several years ago. What you might do is to acquire a small, used TV set still in good condition with respect to sound, and take off the sound across the volume control. Be sure to use a TV set with a power transformer, for otherwise there is a shock danger, as well as the possibility of pronounced hum, when you connect the set to your audio system. Perhaps some reader of this column will come up with a better suggestion.

*Q. I have a **** tape recorder. When I plug in the microphone and move the microphone around I get a lot of static on the tape. Can I avoid this?*

A. Avoid moving the microphone from one surface to another, but keep it steadily and firmly in your hand. Don't move any part of the microphone, such as the swivel or a self-supporting stand. Don't scrape your fingernails across the microphone or allow anything else to rub against it. Otherwise you need a boom and dolly to move a microphone around noiselessly.

Q. I am in the process of making instructional tapes (voice only) covering the details necessary for mechanical subassemblies and welding as well as final assembly of small electrical components and have the following questions. (1) I am using 1½-mil all-purpose tape and plan to keep the original file for reference. What type of storage container should be used? (2) The duplicate, or "working," tape will be used every few months in a manufacturing area where there are punch presses and welding machines. What type of storage container should be used and what precautions should be taken when the tape is near a welding machine? (3) How often should the original tapes be rewound to keep print-through to a minimum? (4) What would you estimate the life of my original tapes to be? (5) Does it add or detract from the life of a voice tape if it is used or just kept in storage?

A. (1) A cardboard container should be adequate unless storage is near magnetic fields. In the latter case, you can inquire about a suitable magnetic shielding container from Perfection Mica Company, 1322 N. Elston Ave., Chicago, Illinois. Ideal storage is at room temperature, moderate humidity. (2) If the welding machine produces a magnetic field, use a magnetic shielding container and keep the tape well away from the welding machine when out of the container. (3) I visualize no appreciable print-through problem with 1½-mil tape unless you have recorded at unusually high level. But it doesn't hurt to rewind. This is best done just before using the tape. (4 and 5) You may expect indefinite life for your tapes under good storage conditions and protection against magnetic fields. A good quality tape can be used—recorded and played—thousands of times. It should last about as long in use as in storage. Æ

AUDIO

MUSIC AND RECORD REVIEW

The Classics

• EDWARD TATNALL CANBY
• OSCAR E. KRAUT
• MARVIN ROTBARD
• LIONEL RUDKO

Pirouette and Melodiya/Angel

We are driven frantic these days trying to keep up with all the new labels making their voluminous debuts in the U.S. market (see AUDIO, ETC, July, Nov., 1966). Low-priced Pirouette, out of Everest, also and somewhat cryptically called Janus (he was the guy with two heads), is based in Canada, with a nucleus of Canadian performances plus the now-usual array of assorted European imports. Everest swallowed up Pirouette so fast, ready-made, that the discs still read "Distributed by Ambassador Record Corp.," of Newark, N. J. Suffice to say that all 21 discs in the enormous first Pirouette/Janus release are available wherever Everest-Baroque-Counterpoint/Esoteric-Cetra-Concert-disc, etc. are sold. Everest would seem to be trying for some kind of corner on the ready-made business! So much the better for the listener, even if he must watch out for occasional Everest-indigestion.

Angel/Melodiya (the separate label was requested by the Russians) is a significant new label in the higher-priced bracket because it is both official and up-to-date. We have had many Russian recordings in reissue form, of gradually improving quality (though unfortunately the older ones are still with us). Now, with full technical maturity in stereo, the Soviets have gone straight to EMI and to our EMI-owned Capitol outlet.

The music is of a high-priced, high-level sort, too, and surely is the best of current Russian production. In view of the aura of this top-rank collaboration, some of it is significant far beyond the purely artistic level, as an indicator of Russian thinking. E.T.C.

Stravinsky L'Histoire du Soldat (Suite). Prokofieff: Quintet for Oboe, Clarinet, Violin, Viola and Bass, Op. 39. Chamber Ens., Rozhdestvensky.

Melodiya/Angel R 40005 stereo

This is an extraordinary recording, both musically and, by implication, politically.

Here you have a top group of Russian performers, on an official state record label, playing the sort of "decadent" Western music that for many years in Russia has been virtually taboo. Though both composers are Russian born, these early works are deliberately chosen from their respective periods of living in the West, as part of the Paris-centered Western tradition, very much outside the Soviet Union. The Stravinsky piece dates from 1918 and practically started the snazzy "modern" trend; the Prokofieff was composed in Paris in 1924, right at the height of the nose-thumbing era—and it sounds it. Most amazing as well as serious.

To be sure, there was no immediate break between music East and West. That came later, when in the mid-thirties the Soviet composers and performers were rudely brought into line with the now-familiar official policy. But even earlier, Soviet music was heading in an utterly different direction, neatly typified by the two Shostakovitch works on another record in this series. After the thirties a long generation of Russian musicians grew up virtually ignorant of all that has happened musically in the West, for better or worse.

But now things are opening up. Time, they say, heals old wounds. And it makes old music safe, too. Benny Goodman, not so long ago, brought old-fashioned jazz to Russia, where it so long had been officially taboo. And Stravinsky paid a visit—after fifty years. Now, the Russians themselves are playing music that is the antithesis of the official Soviet art.

And do they do it well! They're eating it up. True, the Stravinsky sometimes sounds a bit like a Shostakovitch march, and the rude trombone and clarinet raspberry slides in the Ragtime section just sound perplexed. But the essential gritty blariness of this wonderfully controlled musical mayhem is well studied and well understood. They get the idea, all right, and what fun it must be to play such astringent stuff, for a long change!

Prokofieff's later music was all written in Russia, but this youthful Quintet is pure West, in the same acidulous tradition. Beautifully, appreciatively played, and beautifully recorded too.

If the gates stay open, I'll bet the Russians catch up on all fifty years of our music in no time at all. E.T.C.

Shostakovitch: The Execution of Stepan Razin; Symphony No. 9. Vitaly Gromadsky, basso, RSFDR Russian Chorus, Moscow Philharmonic, Kondrashin.

Melodiya/Angel R 40000 stereo

Since official Soviet art took shape almost a half century ago there have been dozens of these big, sprawling "people's" cantatas, usually with a message of some political or historical importance for Soviet listeners, cast virtually always in a style of heavy conservatism, stressing Russian folk music and Russian choirs (which, of course, are splendid in themselves). Sometimes impressive—as in Prokofieff's *Alexander Nevsky*, (film music re-cast into a cantata)—more often they are just massively soggy and wholly unprogressive. That's what we have here.

Stepan (Stenka) Razin is one of those people's heroes out of history. He gets his head chopped off by the Tzar—you'll hear it. Then the head, dripping blood, pulls itself together and laughs straight out at the craven monarch. The end.

It's largely a long bass solo, against a big fat orchestra and accompanying chorus. Beautifully sung, and full of old-fashioned Russian folk effects, as usual. But the atmosphere of toadying to a style leaves me less than convinced; does Shostakovitch really have to go quite so far? It could be less determinedly heavyweight, more economical and, thus, a lot more dramatic. But how often is Shostakovitch ever moved to economy?

Pretty seldom.

The "little" Ninth Symphony is, for this composer, something like Prokofieff's *Classical*— a joyous bit of expert fluff, between larger endeavors. It actually *is* economical, and hardly longer than a Mozart symphony. Rare thing. And a good thing too. (It didn't last. Angel's No. 11 takes 2 LPs.) E.T.C.

Berlioz: Harold in Italy Op. 16. Rudolf Barshai, viola. The Moscow Philharmonic Symphony Orchestra, David Oistrakh, cond.

Melodiya/Angel SR 40001 stereo

Berlioz is an unexpected choice for inclusion in the first of a series of recordings from Russia under an arrangement designed to give us a better view of what is going on there musically. If ever there was a non-conformist and a man who went against the tide and the order of things, that man was Hector Berlioz. His personal feelings, emotions and reactions were, he felt, more important than rules and proper procedures in composing music. But what he had in common with most of the Russian artists, past and present, was a flair for romanticism. In his Memoirs, Berlioz reports that legendary violinist, Paganini, approached him with a commission to write a special composition for viola and orchestra. Paganini had acquired an exceptional Stradivarius viola and wanted to display his prowess on the instrument in public. What impelled the fabulous Italian violinist and composer to choose Berlioz as the most suitable composer to write a show piece for him is hard to figure. Paganini had written all his own compositions and had achieved great success with them, while Berlioz had written nothing for solo instrument of any kind.

Nevertheless, Berlioz accepted and started work. When he showed Paganini the first movement, there was an immediate objection. The viola didn't have enough to play, and Paganini didn't want to stand around while the orchestra took over the limelight between solos. That ended the deal!

Berlioz returned to the task of reconstructing the over-all plan of the solo piece and decided to make a symphonic work of it, based on Lord Byron's epic poem, "Childe Harold." This resulted in *Harold in Italy*, a four-movement poetic symphony with extended viola solo part and the first major work written for solo viola. The viola, incidentally, has a startlingly limited solo library up to the present day, compared to the violin. Interesting to note, Paganini did not play the premiere performance in Paris, November 24, 1834, but did attend and thought enough of the final composition to send Berlioz a check for twenty thousand francs (four years later).

The program of *Harold in Italy* describes Harold's wanderings through Italy and some of his adventures. The composer drew on his own prior experiences when he spent three years in Italy after winning a Prix de Rome in October, 1830.

Two excellent musicians collaborate to give us a really great performance of this symphony with viola obbligato. Rudolf Barshai, better known to us as the conductor of the Moscow Chamber Orchestra, is featured on this recording as the viola soloist. The conductor supplying the musical scenery through which the viola (Harold) wanders is David Oistrakh, taking time off from his familiar role as dean of Russian violinists. Berlioz will seldom fare as well as he does in the hands of Barshai and Oistrakh. No effort is made to make the viola rise and shine above the orchestra by either the artists or the technicians. Everything is subservient to the demands of the music, which is as it should be.

The brooding first movement pictures *Harold in the Mountains*. This section is almost wholly derived from the *Rob Roy Overture* which Berlioz had composed earlier.

The second movement portrays a *March of the Pilgrims*. This inspired Richard Wagner to write a similar scene into his opera, *Tannhauser*. Barshai concludes this movement with a long series of ponticello arpeggios which create an ethereal glassy effect.

The third movement is a *Serenade of a Mountaineer in the Abruzzi to His Mistress*. This is Berlioz, the arch-Romantic at his best. The Orchestra comes shining throughout this portrayal.

The *Orgy of the Brigands* is the title of the last movement. Berlioz gives himself an opportunity for an explosive finish, which summarizes all the material used earlier and is finally brought to a shattering conclusion.

Musically and technically this is the best performance I've heard on disc.

Oistrakh and the Moscow Philharmonic play with a warmth and sensitivity that complement Barshai's performance perfectly. The composer has everything going for him in all departments. O.E.K.

Prokofiev: Symphony No. 5 in B flat. Moscow Philharmonic Symphony, David Oistrakh, cond.

Melodiya/Angel SR 40003 stereo

When the official state recording agency of the Soviet Union agreed to collaborate with Capitol Records in producing a new series of recordings identified jointly as Melodiya/Angel, they lost no time in introducing some less familiar facets of their musical scene. One of the first releases features one of their outstanding artists, David Oistrakh, standing in front of the Moscow Philharmonic with just a baton instead of his more familiar role as violin soloist. The Prokofiev Symphony No. 5 is a major piece of music and it takes a virtuoso orchestra and a top-notch conductor to make it come off successfully. The score is a difficult one to interpret and devilishly complicated to perform. Oistrakh the conductor is entirely consistent with Oistrakh the violinist in that he really takes over with a firm hand and gets right down to business. His interpretation here is entirely original and not reminiscent of anything heard before, which is characteristic of his approach to music as a soloist. It doesn't take long, upon listening to this symphony, to realize that plenty of study has gone into preparing this performance. Details of the score are brought out which were not so apparent earlier. The whole approach is that of digging into the depths of the Prokofiev score in order to create a deeply profound statement. I think the performance suffers as a result.

The first movement bogs down momentarily in a few places due to an overly deliberate tempo that makes it all appear somewhat pompous. The emphasis throughout the recording seems to be on the lyricism to be found and Oistrakh persists in trying to make a romantic out of Prokofiev at every opportunity.

If anyone had the gift of manipulating an orchestra like a magician, it was certainly Prokofiev. He was never one to wear his heart on his sleeve, in fact to the contrary, his compositions all reflect a dry wit and pungency bordering on the sardonic. The elements of his magic are bold use of pure rhythms with pure melodic themes mixed together with some of the most brilliant orchestrations ever conceived. The effects that explode out of his scores come at you with such surprise and rapidity that he grabs the listener's attention and holds it till his conclusion. His scores are fascinating to listen to, rather than moving.

Oistrakh probes for details and misses effects. It might be another case of "not seeing the forest for the trees." The first and the third movements are the weakest portions of this effort. The second movement is a scherzo and bristles with difficulties for the orchestra. The Moscow Philharmonic plays with precision and wide dynamic range throughout the symphony and rises to the occasion in the scherzo and in the last movement. The quality and ensemble are first rate, and level of recording technique employed helps round out a performance that goes for musical values above all else.

The orchestral balance is well nigh perfect and all instruments come through sounding naturally and clearly. I only wish that Prokofiev could have fared as well. O.E.K.

Khachaturian: Concerto for Violin and Orchestra in D minor. David Oistrakh, violin. Moscow Radio Symphony Orchestra, Aram Khachaturian, cond.

Melodiya/Angel SR 40002 stereo

To the best of my knowledge, this new release from Russia, by way of Angel Records, raises David Oistrakh's score to five recorded performances of Khachaturian's violin concerto, two of them with the composer himself conducting the orchestra. The first joint effort is still offered by Angel in the current catalogue listing, as are two other performances featuring Oistrakh with other support. The first recording I can remember was a Mercury release (Mono) which was obviously a conversion from

78 discs to LP, about 1948. At that time it was hard to decide which was more exciting, the new concerto, (which was written in 1940), or the brilliant violinist, who was reputed to be a sensational performer with an outstanding reputation in Russia and Europe. The World War I and other circumstances had kept him from visiting this hemisphere.

Khachaturian had written the concerto for him, and Oistrakh introduced it subsequently to Russia and the world, so it should be no surprise that the artist shows such an affinity for the work. It is after all virtually "his song."

Now, about twenty years later, Oistrakh proves again that he is the outstanding interpreter of this "tour de force" on this latest release. He whizzes through the difficulties as though they didn't exist. He sings Khachaturian's ingratiating melodies with a lush warmth which is unique to his playing. The completely controlled rhythmic drive is, as always, fascinating to hear, and the concerto offers Oistrakh plenty of opportunities to show it.

The cadenza in the middle of the first movement is, I suspect, Oistrakh's own, since it is completely different from that in print. However, it is the same one he has dazzled us with since the outset.

The slow middle movement offers the soloist a chance to pull out all stops in injecting all the "schmaltz" he can muster which, I might add, is considerable.

Essentially this is the same interpretation we have heard on Oistrakh's earlier recordings. What is new is that coupling of the Russian Melodiya tape recordings and Angels' transferral to disc has resulted in a more vivid and natural-sounding performance with an over-all balance which I found completely satisfying. The recording emphasizes the content of the music without sacrificing the brilliance of the performance. All in all, a pretty worthwhile achievement.

Khachaturian and the Moscow Radio Symphony, as might be expected, supply a sympathetic support to round out the effort completely. The result is the most authentic rendition offered thus far on record, and I hope that it is allowed to rest there because the Oistrakh performance shows signs of greater durability than the concerto. O.E.K.

Schumann: Cello Concerto; Five Pieces in Folk Style. Pablo Casals; Prades Festival Orch., Leopold Mannes, piano.

Odussey 32 16 0027 mono

Legendary indeed—both Casals and the fabulous pianist Leopold Mannes. But the music isn't of a showy sort, being Schumann.

Also, Casals is of another generation altogether (and Mannes too). If you already know his style of playing—fine. You'll get your money's worth of legendary music making, and very nicely recorded for the time, shortly after the big war. Also, minus the too-obvious nervous tension and hysteria of some of the Prades recordings made at the actual festivals.

On the other hand, if you don't know Casals by sound, look out. (Also if you don't know Schumann, who can be difficult.) Casals goes back to the older Romantic period, when cellists were allowed to play all around the notes, out of tune, ever so expressively! Though young people may like the sincerity of his playing, they may be shocked by what seems to be its sentimentality and, above all, its inaccuracy. It was the style, remember. It isn't any more. Phew—definitely not. E.T.C.

Mozart: The Marriage of Figaro. Tajo, Gatti, Corene, Bruscantini, etc., Symph. Orch. and Chorus Radio-televisione Italiana, Previtali.

Everest Cetra 424/3 (3) mono

An all-Italian performance of a Mozart opera is an odd experience and likely to shock those who know only the standard German-Austrian versions or the international sort heard in England or America. The odd thing, of course, is that though the music is sung in Italian, written in an Italian opera style of the Eighteenth century, it is really Austrian music, a Northern adaptation of Italian style.

The Italians, especially today, are not really able to cope with this paradox, an alien opera in their own language! Italy hasn't yet recovered from Verdi, Puccini *et al.;* Italian singers still sound like Caruso and his feminine equivalents. They have a tough time with *any* older opera, but especially this Germanic sort.

This reissue of the notable old Cetra-Soria recording (of soon after the war) is the best sort of Italian effort and no ham job. The singers do try their best at the Mozart style and a good deal of it is achieved. But it is really no more than a worthy musical effort; with less good musicianship it would be a travesty. Highly recommended for those who like wider perspectives on their Mozart.

E.T.C.

Beethoven: Cello Sonatas, No. 3 in A, Op. 109; No. 5 in D, Op. 102, No. 2. Jacqueline Du Pre, cello, Stephen Bishop, pf.

Angel 36384 stereo

Two top-level young performers here and their joint music making (also on display in current concert tours) is astonishing for those who know the repertory they play. It's all so very "now" in styling.

Young people today, we keep hearing, are existential, living passionately for the moment, seeking openness, sincerity, honesty, immediate feeling. Perhaps, we older folks tend to think, this is at the expense of perspective. It ignores the great continuing shapes of human life, the architecture of human history. "Now" is such a tiny part of that long architecture! (But don't forget that Hemingway made a whole chapter out of it. Ed.) Education, or merely getting older, can give us a sense of it. But that takes a lot of time. Who has it?

This charmingly musical pair play their Beethoven purely "now." They make it sound wonderfully honest, disarmingly new and very romantic, as much as to say—*look, what we've found! isn't it the greatest?* As though nobody else had ever known.

Now of course that's exactly what music making is for. If it isn't fresh and new every time, this sort of music should surely be left unplayed, in the archives of the dead past. Why resurrect it?

It's all wonderfully fresh, this playing, but it also lacks architecture. It's full of romantic hesitations, sometimes enough to throw you off the track. It dwells lovingly on a turn of a phrase, the shape of a rhythm, the curve of a drawn-out cadenza figure, the faintness of a distant pianissimo. Lovely! Heart warming. But remarkably shapeless.

That driving, over-all intensity of architecture that for so long has been drilled into us oldsters as the greatest Beethoven strength just isn't around any more. Not much of it, anyhow. The long buildings-up of tension, the hard, explosive releases, the cumulative significances of theme, key, contrast, just don't seem to matter as much as they used to. All dissolved away in sincerity.

I loved it even so. These are warm kids and fine musicians, if existential. They probably don't even know they're being existential. E.T.C.

Beethoven: Piano Sonatas No. 28, Op. 101; No. 30, Op. 109. Stephen Bishop.

Seraphim S 60035 stereo

On his own here (and at half the price!), Stephen Bishop does an inpressive job with the two late-Beethoven behemoths, the ultimate test of a pianist's musicianship.

He is still well within the romantic "now" approach described above (the Cello Sonatas). But these later works are more episodic, more moodily passionate, than any earlier Beethoven, full of drastically Romantic changes of pace, introspective and sudden bursts of passion. The "now" sincerity is excellent for this music, and far better than the cold, teeth-gritting hysteria of the young pianists a generation ago. Beethoven can stand sincerity!

Again—loving details, no rushing of the fast parts, a somewhat low-voltage concept of the whole (though Bishop has plenty of physical power in his hands) and a certain lack of shaping in the denser, longer-breathing slow sections. Where a generation ago pedalling was out of style, Bishop's pedal is almost too warm, on the very edge of a dangerous blurring, à la Debussy. Not quite—just a remarkable change in style, within good musical bounds. In the rhythmically fast parts, Beethoven's own force cannot be ignored and Bishop is terrific. But those slow, black-note-cluttered variations find him a bit lost in the mass of sounds, just like many another good pianist. It's almost a rule that nobody plays this late Beethoven *really* well until late middle age—though every youngster tries, and fails, gloriously, often enough. That's Bishop. Don't miss him.

(But then listen to old Schnabel, playing thirty years ago, and see what he does for this same music, with half of Bishop's technique in his fingers. There's the non-existential long line for you, the shape of experience, the eclipse of the "now" by the timeless!) E.T.C.

Mozart: Abduction from the Seraglio. Bohme, Koth, Schodle, Wunderlich, Lenz. Bavarian State Opera Chorus and Orchestra, Eugen Jochum.

Deutsche Grammophon DGR 9215 stereo

During the course of a discussion at which the relative greatness of the old masters came up (a childish and inconclusive pastime too often indulged in). one sage remarked, "Beethoven was the greatest composer, but Mozart was the only one." Well, for the benefit of any doubting Thomas, let me suggest a thorough bout with Mozart's operas. If ever a composer lived whose every phrase and every note is right, it is Mozart. One feels that instinctive rightness and that no other way would have been quite the same.

Hence, an undertaking as important as the recording of a *Seraglio* should require almost a devotion. Not so much out of respect for Mozart but out of respect for those countless thousands who respect Mozart.

The overture is taken at a pretty good clip and, as a result, most of the articulation in the strings is glossed over. While this is insufficient reason to cast a negative note, it is an influence.

Can someone explain why the dialogue is half whispered throughout the opera? I'll admit the plot is ludicrous but it can still be heard half whispered, so why not speak the parts convincingly and perhaps the plot can then become a convincingly amusing farce.

From a musical standpoint, this performance is spotty. The orchestra is not of Vienna Philharmonic quality. Osmin (Kurt Bohme) has a rather dry and colorless voice which he has difficulty with in the upper register. Belmonte (Fritz Wunderlich) and Pedrillo (Friedrich Lenz), the male counterpoints of the unhappy lovers, convey little of either sadness or *amore*. Vocally, they are adequate but not outstanding. Anyone familiar with the early 78-rpm Telefunken recording of Peter Anders' delightful singing of *In Mohrenland gefangen wars* would not settle for Mr. Lenz.

Erika Koth is a reliable and convincing Constanze. While her voice is small and her high notes, at times, heady, she nevertheless manages to maintain a level of consistency which is a decided asset to the performance.

The surprise bundle of this grab bag is Blonde (Lotte Schodle). She has a bright sparkling voice which lightens the spirits at each appearance. She sings effortlessly and sweeps to F above C as nonchalantly as strolling down a boulevard.

The venerable Eugen Jochum keeps all under control with a light hand and never permits a lagging of interest on the listener's part. The fault in this recording lies elsewhere.

The older Fricsay-Stader-Hafliger set maintains, I am afraid, the edge in this instance. Unfortunately, it is not available to us in the wonder of modern stereo. Nevertheless, it is a first rate recording and, played through your stereo set up, you will be amazed at how well it sounds, even monophonically. L.R.

Mozart: Bastien et Bastienne. Stolte, Schrier, Adam. Berlin Chamber Orch. Koch.

Deutsche Grammophon stereo 139213/5

Probably the most remarkable thing about *Bastien et Bastienne* is the startling fact that it was written by a twelve-year-old. Close your eyes and picture a twelve-year-old today . . .

True, this isn't the mature Mozart we all are most familiar with, but here we are witness to the embryo of his genius.

Whether one would want to own this work depends upon to what extent he is a Mozart buff. However, owning the work and owning this recording are not one and the same. This is an extremely dull performance. The soloists and orchestra are competent enough, but they make a chore out of what should be a ball. I would place the burden of blame on the conductor for failing to infuse some sparkle and humor into the music. The elementary nature of this work requires an extra effort by the artists to create and sustain interest. Simply playing notes is not enough. Phrasing, delicacy, precision, tempi are some of the means by which one makes music and not just plays music.

Two other recordings of *Bastien et Bastienne* are presently available. I have not had the opportunity to listen to either. Therefore, I suggest the prospective buyer investigate the other two existing recordings (Nonesuch and Philips) before making his investment. L.R.

Mahler: Das Lied von der Erde (Song of the Earth). Lili Chookasian, Richard Lewis, Phila. Orch., Ormandy.

Columbia MS 6946 stereo

Mahler: Das Lied von der Erde; Five Songs. Christa Ludwig, Fritz Wunderlich, (New) Philharmonia Orch., Klemperer.

Angel B-3704 (2) stereo

It took most of a long and absorbing evening to compare these two great Mahler performances of the same music (with extra songs to fill out the second Angel disc), both recordings issued in the same month. There was only one conclusion as to which was "better"—but that is far from all.

I began with the noble Philadelphia and the two American singers. This is the immense symphony-with-two-voices, based on Chinese poetic texts (in German translation), which Mahler wrote as a kind of personal document on an enormous scale concerning his own final, mature feelings as death itself actually approached him. No one else but Mahler could write so inwardly, so personally, so *privately*, with the resources of a huge modern orchestra, with all the time in the world, for the very biggest voices! The Philadelphia sound, accordingly, is big, expansive, immensely wide in stereo and even a bit distant. A magnificent effect, and the polished orchestra plays as suavely and perfectly as ever. The tenor has the less important role, though he begins straight off—Richard Lewis, in the face of this immense orchestral panoply, sounds a bit underpowered, his voice with a rather heavy vibrato in good oratorio style; but his singing is earnest and dedicated. I liked him. Lili Chookasian has a lovely brilliance in her best tones and can really let loose in Mahler's passionate passages.

Yes, an interesting and persuasive performance at Philadelphia, I thought, if somehow vaguely of a low voltage, rather fast (it must be, to get on two sides!) and almost too well blended in the orchestra.

Then—came Angel. I hate to say so, after having enjoyed the Philadelphia in all good faith, but old Klemperer is a wizard with high-German music of this sort such as Toscanini and Bruno Walter combined. Incredible! I found this performance absolutely hair-raising.

Where the Philadelphia has ineffable polish, this one has soul, atmosphere, overwhelming profundity. Where the Philly solo instruments play throughout the orchestra with impeccable tone and technique, the Philharmonia soloists shriek like werewolves, banshees, or sing like angels, or devils . . . or maybe people. I have never heard such an intensity and singleness of musical thought in an orchestral performance. Every note tells, every entrance, oboe, horns, clarinets, is of a piercing emotional impact, to make you jump.

And though Christa Ludwig has a less colorful voice than Chookasian, she sings with far more profundity and economy, especially at the marvelous ending, fading down to nothing on the mysterious word "*Ewig . . . ewig*." Fritz Wunderlich has a bigger, more Germanic voice than Richard Lewis.

Angel's over-all sound at first seems smaller in scope than Columbia's. But the almost terrifying realness of the solo instruments as they play within the huge, sparsely filled orchestral framework, is a thing not to be missed. Partly it's in the miking, but even more in the playing. E.T.C.

Max Reger: Three Sonatas for Unaccompanied Violin from Opus 97; Sonata No. 1 in A minor, Sonata No. 3 in B-flat Major, Sonata No. 7 in A Minor (with Chaconne). Hyman Bress, violin. **Dover Publications, Inc. HCR ST 7017**

Whenever anyone offers an honest and intelligent service to the cause of music appreciation and understanding, simply, thoroughly, and without fanfare, the least I can offer is my respect and thorough consideration. This offering from Dover Publications is so logically and intelligently produced that I have no choice but to express my admiration for a job well done. They have chosen to contribute this effort toward filling an important gap in music history and discography, occupied by Max Reger (1873-1916). And goodness knows, no one has been able to make a commercial success from any Reger compositions until now.

Max Reger can't be described as a little-known composer. In Germany and Austria, there is what amounts to a cult devoted to perpetuating his memory and performing his compositions. His output was gigantic, totaling in the vicinity of 150 full opus numbers, with multiple composition included under most numbers. For example this recording includes only three sonatas for unaccompanied violin out of the total of seven written under Opus 91. The most cursory glance at his biography and a list of his works offers plenty of evidence that he had exceptional training, talent and skill as a composer. He created quite a stir about the turn of the century composing and performing as a piano soloist and accompanist in Germany and the low countries. He held several important posts in teaching composition, theory, and organ, and pupils flocked to study under him. His understanding of traditional forms of musical composition appears to have been prodigious and he was able to write quickly, easily, and virtually to order. Reger's orchestral works were in direct competition with contemporaries such as Mahler and Richard Strauss for a place on concert programs.

His place and contribution to music were hotly contested during his lifetime and, in fact, still are. Reger considered himself an innovator and was part of that small band, along with Arnold Schoenberg, who felt that a new musical language had to be developed. This group of musical explorers had come to the point where they felt that the musical means of expression had been exhausted and a new means had to be developed. Schoenberg went on to develop his twelve-tone row method of composition. But Reger, who idolized J. S. Bach and traditional forms of composition, took a more conservative approach, though equally subtle and cerebral. He pursued more complex and devious methods of progressing from chord to chord and from one tonality to another. The major problem was that you had to share his musical understanding to appreciate what he was doing and agree that his means of composing justified his end result.

Dover logically chooses these selected Sonatas for Violin Alone for presentation for several stated reasons. Since Max Reger was the first since Bach to write for violin alone and wrote a grand total of eleven sonatas as well as sixteen preludes and fugues in this genre, these recorded selections represent a significant aspect of the composer's output. They also provide an attractive introduction to Reger's work. And, finally, the excellent and exhaustive program notes included with the recording, point out the sparsity of Reger recordings and list every Reger disc produced along with its current availability. The current Schwann catalog lists only five organ works and the recently recorded *Piano Concerto* and *Cello and Piano Sonata.* So this recording is certainly a welcome addition to the catalog.

So we finally get to listen to these Reger pieces and hear a really ear-arresting violinist, Hyman Bress. His sound is lush, warm, and effusive, governed with an exceptional technique. This is solid and strong fiddle playing by someone who digs in and moves along with the feeling of complete conviction in his interpretation. Bress plays musically and with a dash and bravura to make some of the fast movements sparkle. Reger certainly gets full consideration in these performances and an excellent hearing. Chalk up a big plus for Hyman Bress and remember the name, for I am certain that we will hear a great deal more of him.

Now back to Reger and his Sonatas in brief. His style does not sound radical or hard on the ear, quite the contrary is true. He writes effectively for the violin in a robust style with traditional sounding harmonies. Reger uses many unexpected changes and the music twists and turns. The total result is that his fast movements come off quite well as violinistic display pieces. When Reger writes a slow movement the fabric wears thin and the impression is that of an intellectual exercise with no underlying mood or idea. It is here where his "innovations" lose validity and actually defeat their purpose of adding freshness, interest and stimulation. It would appear in these slower movements that Reger is so involved in the means that he sacrifices the musical end, a cohesive, crystalized statement.

However, there is no question that he has mastered a difficult form of composition and even succeeded in going his idol, Bach, one better by producing seven sonatas for solo violin and concluding his seventh with a full length Chaconne. With all the Reger material in the archives, he does merit a wider representation at the listening level and a full opportunity to let us hear what Hindemith, Schoenberg *et al* were shouting about.

To Dover and Bress, "Bravo!" O.E.K.

Couperin: 24th and 25th Ordres. Francoise Petit, harpsichord.

Pirouette (Janus) JAS 19011 stereo

A French harpsichordist and a French-made recording; both are first rate, and the music is particularly welcome—not many of François Couperin le Grand's later works have been recorded.

Françoise Petit's playing is in a sense old fashioned (or perhaps *very* new fashioned); it is full of hesitations and, so to speak, palpitations. First time through, this makes the highly ornamented Couperin music a bit hard to follow in its detailed sense. But one very quickly gets to feel the rightness, the musicalness, of her style. It grows on you. The harpsichord is unusually well recorded. A minimum of twang and buzz and clunk of machinery (too often heard on other records), a maximum of that elegant, silvery clarity which is the true sound intended for the listening ear.

Oddly, the record makes excellent "classical background music." Couperin lends well to casual but informed polished successions of little bits and pieces, deliberately minus any large-scale architecture. Leave that to the Germans, might be the implicit message. Leave it, maybe, to Bach, Couperin's younger contemporary. E.T.C.

Bach: Cantata No. 76, Der Himmel erzehlen die Ehre Gottes. Soloists, Choir and Orch. Dresden Cathedral, Bauer.

Pirouette JAS 19009 stereo

These East-German performers have appeared recently on a sister label, Baroque, at (nominally) twice the price. See the March issue. They are more at home here in Bach than in that more expensive (nominally) Beethoven disc: but the stereo is here "re-processed" and there is some mild distortion, though not enough to bother a musical ear.

This is a big cantata, for some special occasion, with enlarged orchestra and music to match. It's a good performance, with an enthusiastic chorus, a nice orchestra, and four competent soloists anonymous. The soprano is a lot more than that—she is excellent. So is Bach himself. It's one of his grandest big pieces. E.T.C.

Attaingnant, Couperin, Marais, Purcell, Telemann, Veracini. L'Ensemble Baroque de Montreal.

Pirouette JAS 19001 stereo

An excellent disc, well played and well recorded too, but the information snafu on it is monumental, in both French and English. Three lady players—no mention as to which plays what, except in the implications of the bio material. (Well, Miriam Samuelson plays the recorder, I gather.) To find out what music is being played you must stop the record and read its label. Fine thing! Nothing on the jacket, front or back, in the way of an ordered program. Then, just to confuse you further, you may read on the same labels, in addition to the correct copy, *BACH, CONCERTO IN F MAJOR S. 1057. . . .*" On both sides, too. As of deadline time, I had not yet found the Bach. Maybe in next month's release??

Nevertheless, it's a fine disc. Variety is well managed musically, with three Baroque works to continuo accompaniment (Marin Marais, Veracini, and Telemann) interspersed with harpsichord solos (Couperin and Purcell) plus a set of older (16th c.) dance tunes (Attaingnant). One technical faux-pas: the solo harpsichord pieces are suddenly too loud and too close, as compared with the adjacent ensemble works. The tyranny of the VU meter, I guess. E.T.C.

Light Listening

- RICHARD L. LERNER
- CHESTER SANTON
- ROBERT SHERMAN

Enoch Light: Spanish Strings
Project Three 5000 SD

Enoch Light's latest label actually lists itself as Project 3. The word "Three" has been substituted in the heading above lest a quick-glancing reader assume the number of the album to be 35000 SD. This latest series by Enoch Light shows a lot of promise and deserves purchase by more audiophiles than those merely curious to see whether Light has surpassed earlier record projects. If we follow his numbering, we can assume that Light considers his Grand Award label as Project #1 and the Command discs (whence came the bulk of his fame and fortune) as the second. There was a time in the earlier days of stereo when every convert to the new medium had at least one Command record on hand to prove to his still-mono-only friends that stereo effects could be created with music on any sort of playback equipment. During that giddy period Enoch Light was much too busy finding enough banks to hold his earnings to worry about what purists had to say about the ping-pong concept underlying most of his Command best sellers. In his latest project, Light has settled down but not back. He is now betting his money on two basic ideas. The first is very expensive (in raw material costs) and highly commendable from an audio standpoint. This is the use of 35-millimeter magnetic film in the master recording. The advantages of film can be easily detected on any good home system. The reduction of noise level in the master is worth the added cost. Arranger Lew Davies had a relatively silent background on which to work and he took every advantage of it. You'll spot this immediately when the only sound on the record is the solo harp of Robert Maxwell at the start of a piece or an introduction to a Spanish selection that starts with the solo guitar of Tony Mottola. The usual masking of a solo instrument's clarity simply doesn't exist on this record. Instrumental separation (as opposed to stereo separation) of the entire orchestra benefits in similar fashion. When the playing of the orchestra is outstanding, as it is here, you really know it. *Spanish Strings* is too modest a title. This large ensemble has a lot more to offer than strings. This is a full-fledged orchestra with ample percussion, alto and regular flute played by Stan Webb and Phil Bodner, and the soaring trumpet of Doc Severinsen in addition to the distinctive touches of Maxwell and Mottola mentioned above. The repertory is sure-fire Latin stuff that lends itself to exotic treatment. So far, so good. Everything on the master is really great. Now the heavy hand of commercial recording practice comes into the picture once the sound is transferred from tape to disc. It is here that we come to a problem that may prove to be the undoing of stereo pickup cartridges that were considered pretty good items several years ago, and still are today—on conventional records. I don't know what they've done to the level on this disc but it surely cannot be called conventional modulation by any stretch of the imagination. My copy of *Spanish Strings,* despite a volume setting appreciably lower than what I use for most pop discs, is capable of throwing a 0.5-mil spherical stylus out of the groove in more than one place in the course of this record. If cutting at this modulation level becomes commonplace with some labels, it could well mean a stimulus to sales of the latest generation of super-tracking stereo pickups. For the present, however, it could merely mean a sudden increase in the number of record buyers going back to their dealers with what they consider a defective record. In a case like this, the ball could bounce either way. During a given year, I go through more discs of popular music than the average buyer. Tracking has not been one of my problems—until this record came along. My review copy could be a defective one, yet a second copy, this one from a dealer's regular stock, acted up in the same way. If the entire Project 3 series presents similar tracking problems on some existing pickups, many audio/buffs may well buy at least one disc in the series to check out any one of the very latest stereo pickups that stress tracking performance in their specifications. C.S.

Don Adams. Get Smart.
United Artists (Ampex Tape)
UAX 6533 stereo

I listened. I laughed.

These are fourteen sound excerpts from the television series that has made "sorry about that" a national phrase. They are good, and they are funny. Adams' delivery, and that of his co-stars, is ideally broad for this kind of farcical situation. For example:

Adams as Leftenant Faversham (a la Cary Grant) confronting Adams as the Oxford educated Mohammed Sidney Kahn.

Faversham: All right, smarty-kahn, don't think you've got me . . . I've got you surrounded by the entire mounted division of the 17th Bengal Lancers.

Kahn: I don't believe that.

Faversham: Would you believe the *1st* Bengal Lancers?

Kahn: No!

Faversham: How about Gunga Din on a Donkey?

Well, that's the kind of stuff this is.

R.L.L.

American Airlines—Eleven Classical Renditions.
Ampex Tape CW4 stereo

Here is another three hours of background/foreground music, exactly as heard on an intercontinental flight on American Airlines. All of the selections are baroque-classical period. All are from the Nonesuch stable. This full tape gets its three hours by playing at 3¾. I continue to be amazed at how good music can sound at this speed. Not that these tapes represent the ultimate, for there is quite a bit of variability from selection to selection, but I suspect that this is in the masters.

Each of the selections is complete. Thus there is all of the Haydn Symphony No. 86 and Symphony No. 82. And nine other works of like worth. This is an album that, because of the sheer volume on it, must be considered as fodder for background sound. It is just too complex to find one of the selections otherwise.

So, if it is gently playing background music you want, here is a fine single source. R.L.L.

Los Indios Tabajaras
RCA Victor LSP 3611

Listening to another easy-to-welcome release by Los Indios makes it clear why simplicity has paid off so well for these South American artisans of the guitar. In the hands of the right performers, only two guitars are required to provide a half hour of relaxed listening pleasure. As with any other thoroughly satisfactory recording, there are two facets involved. The musicians know what they're doing and the recorded sound sets up minimum barriers between performer and the owner of a *bona fide* sound system. The lead guitar in the left channel provides just enough adornment to the familiar tunes to keep the ear pleasantly occupied and serves to identify this unique duo. The more guttural guitar on the right keeps any woofer happy enough so that it barely notices the discreet percussion used very lightly in the background. Los Indios Tabajaras, as many record buyers know by now, are two Indian brothers from the jungles of South America who have proved that it is possible to make the transition from native music to pop tunes of this country by means of exceptionally voiced guitars. Now that they've made several albums for RCA Victor, some of Los Indios' unworldly approach has been diluted to some extent by inevitable contact with our music industry but enough remains to set this apart as a distinctive record for background listening. C.S.

Theodore Bikel: A Folksinger's Choice.
Ampex/Electra tape EKC 7205 stereo

Fans of Bikel will want this latest offering from this singer/actor. However, one can't help wondering who the folk-singer was that made the choice for this album. The numbers are: *Haul Away, Joe, Damsel of 19 Years Old, Dance to Your Daddy, Vicar of Bray, Charladies Ball, Trooper and the Maid, Tail Toddle, Away With Rum (By Gum), Highland Muster Roll, Wallaby Stew, Co-operative Cookies, Springhill Mine Disaster, Limerick Rake, The 42nd, Carlton Weaver, Come Away Melinda.* Followers of this folk-type music will see that there are some that are familiar and some that are not. More to the point, however, is the similar mold that each of these songs seem to come from. They are all of high good humor. And Bikel does sing them as they should be sung. He does have a way with these songs.

No, my criticism is that the album does not seem to be what I would think Bikel would pick as his favorites. At least not to the exclusion of the tender, tragic kind of song he also does so well.

This Ampex tape manages to capture the bright and forward sound that we expect from Electra. It is also clean and flutter-free. All told, then, this makes a first-rate production. R.L.L.

Caravelli Strings: Michelle
Columbia CS 9324

Readers of this column whose recollection of its record reviews goes back several years will understand why I'm puzzled by this release. Such readers are fairly well aware of the fact that I've been partial to the sound quality obtained by European recording crews. Yet here is a European recording (from France) that has me wondering. While techniques in Europe have always varied slightly from country to country, by and large, a foreign recording, even in the case of popular music, invariably gave the impression that its producer was aware of progress in expensive home playback systems and tailored his product accordingly. Some of the finest popular records I've ever encountered have come from England and Germany but other areas on the Continent have supplied their share of discs that are a credit instead of a liability on a wide-range system. Whoever turned out this debut recording by Caravelli and his Strings took his cue from American producers of records for the juvenile market and loaded it with all the pre-emphasis and echo chamber our industry has been using to make some of its products "impressive" on a $30 teen-age phono. The teen-age market is an undeniable fact of life around the world but I can't help being puzzled by the apparent decrease in the number of adult-oriented releases in Europe. Aren't we constantly being told that sales of bona-fide high-fidelity components are still holding up well over there? C.S.

Bullfight. Roger Laredo, musical director.
London Phase 4 SP 44082 stereo

This is not the first Bullfight-type record, though it may be the first partly recorded during an actual Corrida. The whole of the first side is given over to the slightly less than 20 minutes that it takes to slaughter a bull. The miking job is fabulous. The crowd, the band, the matador, and the bull are in the room with you. Fortunately, it is a re-creation.

The exaggerations of Phase 4 sound are perfectly suited to this super-fi kind of performance. The effect of this side is quite uncanny. You will hear the sounds and music that accompany the battle as it is staged in Madrid. This is spectacular sound indeed.

Side two is more perfunctory. An unknown orchestra or flamenco troupe play standard Spanish-type fare. (Lecuona, Granados, Pena, and De Falla.) The orchestral works are impressive in Phase 4. However, the flamenco number, Bulerias, played by guitars and dancers, is strangely muted. It's all very peculiar.

This is a record for the bloodthirsty, or at least, the curious. And the album *is* well illustrated. R.L.L.

The In Sound from Way Out
Vanguard VSD 79222

These days, the Vanguard label makes its major excursions into the popular field only in the case of folk music. When it does decide to put out a "pop" release, it's apt to be something a bit off the beaten track. That certainly is a safe enough description of *The In Sound from Way Out.* The idea here is a novel one that probably was quite promising in the early stages of discussion that preceded its production. The finished product is something else again. Considerable credit should go to producers Jacques Perrey and Gershon Kingsley for the scope of their ambitions: the creation of a recording of electronic pop music. *Musique Concrète* has been around for some time but until this disc came out I had never heard the electronically created sounds of *Musique Concrète* applied to the rhythms of popular music. Underlying the complicated sonic structures of the electronic stuff is a beat created by live musicians using both natural and electronic instruments. All matters relating to the musicians used in the project were in the hands of Gershon Kingsley, a graduate of the Los Angeles Conservatory, Columbia University and the Juilliard School of Music. On Broadway he served as arranger and conductor of *La Plume de Ma Tante, Fly Blackbird* and the revival of *Cradle Will Rock.* Arrangements for past Vanguard albums include Netania Davrath's *New Songs of the Auvergne,* Jan Peerce's *Neopolitan Serenade* and the swinging *Mozart After Hours.* His acknowledged versatility was undoubtedly a factor in his selection as partner to Jacques Perrey, an authority on electronic music who handled the rest of the chores in this assignment. The chores of dubbing and splicing must have been considerable and yet, after many patient hours in the laboratory, the Perrey-Kingsley synthetic sounds end up as no more than embellishment to the hints of bossa nova, rock, or blues set forth by the studio musicians. If you add up the number of man hours consumed in the production of this record, it may well be years before another record label attempts another electronic job of this nature. C.S.

Paul Mauriat Orch: Of Vodka and Caviar
Philips PHS 600-215

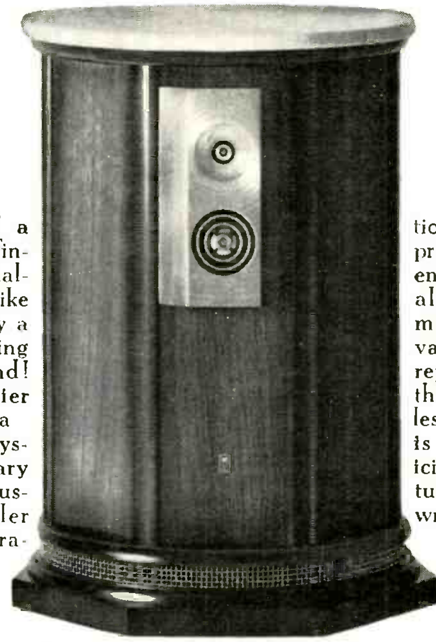
The appetizing heading above tells you just about all you have to know about this one. The combination is a trifle on the unlikely side, musically speaking. Here is a French orchestra playing songs long identified with Russia. By now, of course, most of us have grown used to the idea of finding a highly international approach on the Philips label since they do very little recording in this country. The idea of having *Meadowland, Dark Eyes,* and *Volga Boatman* arranged by a Frenchman becomes less farfetched as one progresses into the album. Mauriat has as good an imagination in these matters as the next non-Russian arranger. For that matter, how often do we hear these tunes played by Russian orchestras on Russian record labels? Listeners who insist on something more than a popular approach to this type of music are advised to do more of their shopping on specialized labels such as Monitor, Bruno, and Artia where authenticity is usually the order of the day. The only real competition this record will have is the recently reissued Vanguard disc of Russian folk songs in polished instrumental versions by the Decameron orchestra. This Philips release has perhaps a higher percentage of familiar stuff than Decameron offers and its male chorus is quite helpful with its occasional embellishments. The sound is quite typical of the current Philips product. If your listening room is on the live side, sustained passages of music will sound impressively rich but use of the echo chamber giving you such deceptively full sound will become apparent as soon as the orchestra pauses after a chord. A heavily draped room should accept this as a more or less normal record containing few other gimmicks discernable in the transfer from tape to disc. C.S.

Mexico Lindo
Capitol ST 10449

Here is a chilling example of a self-defeating approach in recording a Mexican Mariachi Band. In this instance of a Capitol disc made on foreign soil, the label doesn't even have the excuse of a provincial recording locale. The Mariachi Ora y Plata heard here were recorded in Mexico City where equipment is far from primitive, as Capitol and other labels have demonstrated in the past. The whole point of the sound of a Mariachi street band is missed in this recording. Instead of the informal out-of-doors effect that is the stock in trade of the carefree strolling Mariachi with their trumpets, violins, and guitars, the sound here is more enclosed and boxed-in that that of the average studio recording. Part of the blame must lie with the Capitol "Full Dimensional" Stereo process. Introduced some time ago as Capitol's answer to the Victor Dynagroove system of recording, this so-called Full Dimensional process has a long way to go before it can begin to live up to the lofty sentiment claimed in its name. On average, it delivers a far more confined type of sound than either Dynagroove or the older Columbia "360 Sound." In the case of Mariachi music, the heavy use of echo chamber and the cramped frequency range are more out of place than ever. This is not an automatic demand on my part that all street bands, no matter where located around the globe, be taped out-of-doors to the exclusion of studios of any kind. If Mariachi music happens to appeal to you, there are available many other examples of it that preserve the raffish excitement of the moment in room ambience that does it justice. C.S.

Today!: Mississippi John Hurt, accompanying himself on the guitar
Vanguard VSD 79220 (stereo)

At least John Hurt had a few brief years in the sun. Blues collector Tom Hoskins found the stoop-shouldered, 70 year-plus farmer living in Avalon, Mississippi, and introduced him at the 1963 Newport folk concerts. Hurt was the sensation of the Festival, the audience cheering his uncanny ability to infuse even the most earthy, low-down, uninhibited songs with deep warmth and tender humanity. After a lifetime of obscurity, he was suddenly in demand—in recording studios, on college campuses, in clubs and folk cafés around the country. John Hurt died a few months ago, and so this album, originally intended to document the spectrum of his current musical activities, must stand instead as a tribute to his memory. A superb tribute it is, though, with a dozen of his matchless settings of ballads, blues, dance tunes and spirituals. You'll find no shouting here, no vocal virtuosity, no melodramatics. Mississippi John made his points with a whisper, and in his own quiet, unpressured way, he could cull from a song its full measure of bitterness, or sorrow, or joy. Among the especially satisfying numbers are *I'm Satisfied*, with its infectious spirit of buoyant self-confidence, *Spike Driver's Blues*, a fascinating variant of the old John Henry legend, and *Hot Time in the Old Town*, a pop favorite transfigured by Hurt's imaginative, sensitive treatment. For all its sad reminder of a remarkable talent that is no more, the recording remains a glowing portrait of a man who was firmly, if belatedly hailed as one of America's truly great minstrels. R.S.



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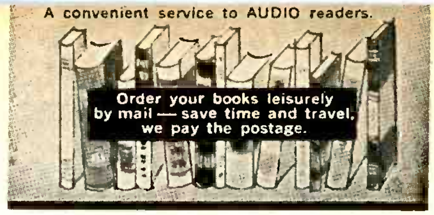

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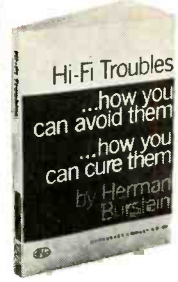

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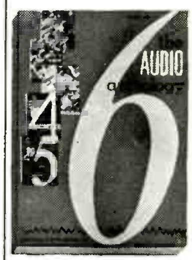

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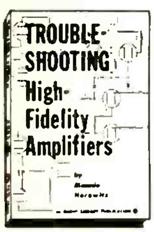

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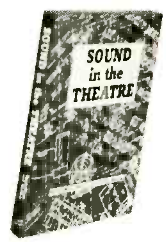

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Jazz and All That

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Cannonball Adderly: Mercy, Mercy, Mercy

Capitol Stereo ST2663

The Cannonball Adderly Quintet, consisting of "Cannonball" Julian Adderly on alto, brother Nat on cornet, Joe Zawinul, piano, Vic Gatsky, bass, and Ron McCurdy, drums, is probably the most solid, steady, and consistent of the mainstream combos performing today. They can be counted on to swing in a healthy extrovert manner, and the present set, which includes two compositions each by Nat, Julian, and Joe, gives them exactly the right material to work with. The live recording, made in Chicago at The Club, has a continuous background of audience sound. There are spoken introductions to most of the numbers, and there is loud applause at the end of each. Somehow, it fails to get in the way of this rewarding entertainment.

The Misty Sax of Ace Cannon

Hi Stereo SHL 32035

Altoist Ace Cannon, supported by a small group of strings, presents a curious collection of pop and standard material in his sweetly country-and-western Nashville manner. His selections include *Wonderland by Night, Almost Persuaded, Somewhere My Love, Blowing in the Wind, As Time Goes By, Yesterday, Michelle, When a Man Loses a Woman, Strangers in the Night, You'll Never Walk Alone, That's My Desire,* and *Summertime.* Cannon is an able and secure musician whose work should be of interest to anyone who specializes in the alto saxophone. He is that rare phenomenon, a craftsman whose technique transcends his medium.

Johnny Hodges, Wild Bill Davis: In Atlantic City

RCA Victor Stereo LSP-3706

The appearance of the Ellington Band at Atlantic City's Steel Pier was the opportunity for Hodges and trombonist Lawrence Brown to get together with Wild Bill Davis at Grace's Little Belmont, the organist's regular summer location. The rest of the group is composed of the members of Davis' regular quartet: Bob Brown, tenor and flute, Dickie Thompson, guitar, and Bobby Durham, drums. Hodges' alto is most secure when he is playing his own music and music normally associated with the Ellington Band, and the selections on this release fit the groove comfortably for the kind of solid delight one can expect this headliner to deliver. *Rockville, Good Queen Bess,* and *LB Blues* are all by Hodges. *Belle of the Belmont* is a Mercer Ellington-Hodges number, *Taffy* was written by Hodges with Wild Bill Davis, and the rest of the session consists of one more Davis number, *I'll Always Love You,* Ellington's *It Don't Mean a Thing (If It Ain't Got That Swing),* and the Rose-Harburg-Arlen standard *It's Only a Paper Moon.* It must have been sheer hell for engineer Ed Begley to record in the cramped, noisy atmosphere of this very popular night spot. No detail of the music is obscured by background chatter, but the noise is there, and it's constant. Stereo effect is largely right or left with very little in the center. But there's a great deal of very fine music on this disc, and you may find such technical complaints overly fussy.

Steve Kuhn, Gary McFarland: The October Suite.

Impulse Stereo AS 9136

For the first release in its special virtuoso series, Impulse commissioned Gary McFarland to compose and conduct a set of pieces featuring the 28-year-old pianist Steve Kuhn. In addition to Kuhn, Ron Carter, bass, and Marty Morell, drums are supplemented on side A by a string quartet. On side B they are joined by a harp-and-woodwind quartet. For each of these groups, McFarland has written atmospheric backgrounds that serve to punctuate the almost unbroken narrative of the piano. Kuhn improvises freely against sensitive settings that afford him plenty of elbow room and provide wonderful patches of contrasting color. What McFarland has created is a set of jazz concerti grossi in which the quartet performs the role of the *ripieno* and Kuhn, Carter, and Morell make up the *concertino.* There is an agreeable shifting from extreme freedom in the solos to quite rigid formality in the quartet passages. This is a release of exceptional interest and merit. As the first of a new series, it whets our appetite for more.

Herbie Mann: New Mann at Newport

Atlantic ALC 1471

(4-track stereo tape)

Recorded at the 1966 Newport Jazz Festival, this bright, sonically diverting tape features a wide variety of directional effects, the crisp Latin percussion of Carlos "Patato" Valdez, brilliant trumpet work by Jimmy Owens, the highly rhythmic trombones of Joe Owens and Jack Hitchcock, Bruno Carr, drums, and the exceptionally well-recorded bass of Reggie Workman. For Mann, the performance was clearly a triumph. Although he solos only rarely on these five tunes, his personality dominates the performances and sparks the audience excitement. While that excitement is quite evident, it is a pleasure to note that the excellent close-up recording minimizes background interference. The most important Mann solo is on *She's a Carioca.* It is an extended, brilliantly swinging improvisation that Mann admirers are likely to class at the top of his collected works.

Oscar Peterson: Something Warm

Verve Stereo V6-8681

This is the third set of live recordings made by Peterson at Chicago's London House in 1962. At that time he had the backing of Ray Brown on bass and Ed Thigpen on drums. His work with these two men has produced some of the most notable playing in his career, and the current offering is worthy of this trio at its very finest. Peterson is at his most breathtakingly glib ease as he breezes through *There Is No Greater Love, I Remember Clifford, Autumn Leaves, Blues for Big Scotia, Swamp Fire,* and *I Love You.* Considering the conditions under which the performances were taped, the sound is superior. It is unreasonable to hope that there may be the makings of one more disc from these fabulous 1962 sessions?

Kid Thomas Valentine and His Creole Jazz Band

Arhoolie Mono 1016

In 1952 I heard Kid Thomas play a concert at Charity Hospital in New Orleans. His playing was accurate but not very imaginative, and his tone was clear but small. At that time there were still several horn players of substantially greater stature in the Crescent City, and I tentatively classified Kid Thomas as an able, minor talent. The present recording, made in 1959, documents a very sad decline in the powers of a musician whose chief claims to distinction were simply that he was alive and playing at the same time and place as a number of greater and more famous men. He, and the other men at this session, are among the last survivors of a great tradition. But there is very little on the present platter to suggest anything of that tradition. The group, in addition to Thomas, includes Manuel Paul, tenor, Louis Nelson, trombone, Creole George Guesnon, banjo, Sammy Penn, drums, and "Slow Drag" Pavageau, bass. Thomas and Paul are both old time members of the Eurega Brass Band; Pavageau, the oldest and ablest of the group, is remembered for his work with Bunk Johnson and George Lewis. All of the others have had similar associations with great bands of an earlier day. But somehow nothing of the great lift and joy of a real New Orleans performance is to be found here, and the amount of off-pitch and out-of-time playing is greater then even the most devoted "moldy fig" unreconstructed purist can be expected to tolerate. Arhoolie deserves great credit for its dedication in tracking down and preserving fine traditional material. It's a pity they didn't let this one get away. Æ

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THE PERFECT GIFT for the audiophile. The unique TRANSCRIPTOR stylus pressure scale is a laboratory-type instrument, accurate to 1/50th gram. Jewelled unipivot bearing, bubble read-out, adjustable cursor, supplied complete with weights and tweezers. Whether stylus pressure is pre-set on your equipment or relies on you for regularing, the TRANSCRIPTOR stylus scale gives the final OK. $7.95 including air postage. Wilmex Limited, Compton House, Malden Road, New Malden, Surrey, England.

AMPEX 300—3 track—½ inch tape recorder. Sel-sync. Console cabinet, excellent condition with extra set of heads. $2500 fob. Mastertone Recording, 130 West 42 St., N. Y. C.

PERSONAL RECORD COLLECTION for Sale. Classical, Jazz, Country-Folk, Foreign, etc. All one owner and many played just once or twice on Professional tone arm. Send for Lists. Allerton H. Hawkes, 58 Hardy Rd., Westbrook, Me. 04092.

TAPE RECORDER SALE. Brand new, nationally advertised brands, $10.00 above cost. Arkay Sales Company, 1028-H Commonwealth Avenue, Boston, Mass. 02215.

ACROSOUND Ultralinear II 60 watt power amplifier. Pair for stereo $120.00. J. M. Edelman, M.D., 4550 North Blvd., Baton Rouge, La. 70806.

MODEL 210 CRAFTSMEN TV tuner. Excellent condition, including 21-inch tube, 35 feet coaxial cable, all mounting hardware, schematics. Best offer. Joseph Mazoff, 3720 Cambridge, El Paso, Texas 79903.

EQUIPMENT WANTED

SHERWOOD S-3000 V Tuner. Stereo Tape Recorder, 10½" reel type. M. Shorr, 111 Mt. Hope Pl., Bronx, N. Y. 10453.

QUALITY RECORDER; tuner: Marantz, Scott Etc. Sealed Replies, Joe Wheeler, 2664 Benny, Rancho Cordova, California.

WANTED. Fairchild compander. Robert Hawkins, 434 West 120th, N.Y.C. 10027.

WANTED: Used Heathkit 21" color T.V. set, in good condition. Also Dual 1009 in good condition, base and dust cover. Write Stephen McGarity, Box AJ-1. Send price quote and condition.

WANTED — Ferranti ribbon arm and pickup head—less transformer, complete or parts. Dan Seigel, 191 Frederick St., #24, San Francisco Calif., 94117.

WEATHERS Hide-Away Woofer System, with low-pass filter. Richard McCarthy, 1114 Carondelet Bldg., New Orleans, La. 70130.

WANTED: Used Fisher X-1000 Integrated Stereo Amplifier. Please state price and condition. W. O. McKnight, 2219 Wilson Ct., St. Joseph, Michigan 49085.

WANTED—J. B. Lansing 175 DLH, N-1200, 130 A—All 16 ohms. Victor Vine, Box 145, Keuka Park, N. Y. 14478.

WANTED TO TRADE

CONCERTONE S505K, excellent, for Revox G36. E. Patrone, 40 W. Drive, Providence, R. I. 02904.

EMPLOYMENT

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Specializing in Music-Recording
251 W. 42nd St., N.Y.C.
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POSITION WANTED

AIR FORCE VETERAN: Desires job as High Fidelity Salesman; extensive Practical Knowledge in High Fidelity. Experienced Audiophile. Martin Caulfield, 4026 68th Street, Woodside, N. Y. 11377.

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