...the original magazine about high fidelity!

15th Anniversary Issue
NOW...A NORELCO CONTINENTAL TAPE RECORDER FOR EVERY PURSE AND PURPOSE

WHETHER YOUR PARTICULAR REQUIREMENTS IN A TAPE RECORDER ARE SIMPLE OR COMPLEX
...WHETHER THEY REFLECT THE DEMANDS OF YOUR HOBBY OR YOUR PROFESSION...
WHETHER THEY STRESS LISTENING OVER RECORDING OR VICE VERSA, OR PROFESSIONAL QUALITY OVER PORTABILITY OR VICE VERSA, CHOOSING THE ONE RIGHT TAPE RECORDER FOR YOU HAS NOW BECOME AS SIMPLE AS A-B-C! FOR THERE ARE NOW FOUR NORELCO CONTINENTALS. ONE FOR EVERY PURSE. ONE FOR EVERY PURPOSE.

ALL GUILD-CRAFTED BY PHILIPS OF THE NETHERLANDS. EACH DESIGNED TO PROVIDE ITS OWNER WITH THOSE FEATURES BEST SUITED TO HIS SPECIAL REQUIREMENTS—WHETHER ON VACATION, ON LOCATION, IN THE HOME, STUDIO, OFFICE, CHURCH OR SCHOOL.

CONTINENTAL '100' (EL 3585) shown on top: transistorized, 7 lb., battery portable • records 2 hours on 4" reel, from any source • plays back thru self-contained speaker as well as radio, TV or record player • response: 100-6000 cps • tapes interchangeable with other 2-track 1½ ips machines • constant-speed operation • complete with dynamic microphone.

CONTINENTAL '200' (EL 3541) shown bottom right: 4-track stereo head output direct to external stereo pre-amp for portable high fidelity tape-deck applications • completely self-contained for 4-track mono record and playback • mixing facilities • lightweight, compact, rugged • dynamic microphone.

CONTINENTAL '300' (EL 3542) shown second from top: 4-track stereo playback (tape head output) • self-contained 4-track mono record/playback • 3 speeds • dynamic microphone • ideal for schools, churches, recreation centers, etc. • choice of audio-phones seeking top quality at a sensible price.

CONTINENTAL '400' (EL 3536) bottom left: 4-track stereo and mono recording and playback • 3 speeds • completely self-contained, including dual recording and playback preamplifiers, dual power amplifiers, two loudspeakers and stereo dynamic microphones • frequency response: 50 to 18,000 cps at 7½ ips • wow and flutter: less than .15% at 7½ ips • signal-to-noise ratio: -48 db or better • cross-talk: -55 db.

For a convincing demonstration of these features and qualities, visit your favorite hi-fi or photo dealer... or write for brochure to:

NORTE AMERICAN PHILIPS COMPANY, INC., High Fidelity Products Division, 230 Duffy Ave., Hicksville, L. I., N.Y.

IN CANADA AND THROUGHOUT THE REST OF THE FREE WORLD, NORELCO CONTINENTAL IS KNOWN AS THE PHILIPS.
To celebrate our 15th Anniversary...

Audio looks at the past 15 years through the eyes of C. G. McProud (p. 19); traces the development of stereo recording through anecdotes and the reminiscences of R. J. Tinkham (p. 25); presents a gallery of some of the pioneers who contributed to the audio art (p. 32); and then we take a look, from a variety of viewpoints, at the development of the recording industry — the lookers are 1947-48 (p. 70). Looking the other way we have some thoughtful and thought-provoking predictions of what the next 15 years might bring (p. 68). To round out the picture, Norman Crowhurst examines the present state of the audio art in general (p. 6) while G. F. Cooper looks at the specific area of transistors (p. 22). Herman Burstein casts his experienced eye at the status quo and trends in the tape field (p. 62). As an encore we have presented some "new products" of the vintage 1947-48 (p. 70).
Preserve the Genius of the Masters with the

Natural Sound of Tandberg

MODEL 6 3 SPEED 4 TRACK STEREO RECORD/PLAYBACK TAPE DECK

The remarkable features of this superb unit speak for themselves — records 4 track; plays back 2 and 4 track stereo and mono; records/plays back FM Multiplex Stereocast with magnificent clarity, even at 3 RPM. Permits sound-reproduction for entertainment on tape, and professional recording using a two-channel stereo recording equipment. Remote control "FM" model also available.

MODEL 65 3 SPEED 4 TRACK STEREO PLAYBACK TAPE DECK

Another Tandberg triumph — for pure playback of 2 and 4 track stereo and mono tapes with finest frequency response. Extremely versatile; facilities for adding erase and record heads. Price $199.50.

Tandberg remains unchallenged for clear, crisp, natural sound!

On Our 180th Issue

IHFM

Congratulations to AUDIO on its 15th Anniversary!

Fifteen years of combined service to high fidelity and to the records industry have provided the Gratitude of the Institute of High Fidelity Manufacturers. We in the industry, and personally, are aware of the important role AUDIO has played in the past by encouraging, and participating in, significant industry actions—not the least of which was helping to found the IHFM.

Again congratulations.

RAY FETE, President

AES

Sir:
The Audio Engineering Society is proud of and grateful for the long history of constructive cooperation between AUDIO and the Audio Engineering Society beginning with the publication of the society's papers by AUDIO before the society had its own journal and continuing with the fine coverage of Audio Engineering Society news and features by AUDIO magazine.

The past fifteen years have seen the science of audio grow from sound reproduction only noticeably better than early radio and phonograph reproduction to a point where it is often almost impossible to determine whether the music is "live" or reproduced. We have had improvements in amplifiers, records, tapes, and tuners, providing a net improvement which would have been thought impossible a few years ago. More recently we have had stroboscopic records, tapes, and multiplex FM broadcasting, providing not merely an accurate reproduction of the music, but a locked up by the microphone even though a two-channel spatial representation of the original sound may be used to operate as the earlier single-channel types.

Congratulations to AUDIO on its fifteenth anniversary, and may the next fifteen years be even more rewarding.

HERMAN HOSMER SCOTT, President

MRIA

Sir:
The magnetic recording industry and AUDIO have shared an exciting decade and a half when both were young and growing.

We started first, slowly, in laboratories more than a half century earlier. We didn't reach the marketplace, however, until after World War II. It was AUDIO's first year, 1947, when the first tape—a black oxide product on paper backing—went on sale, to be followed within a few months by the now familiar plastic backing. We began to grow. Bing Crosby gave us a spectacular assist when he revolutionized the technique of broadcasting by transcribing his radio show on tape.

Tape for entertainment, however, suffered through a black and humiliating period in the late 50's when the stereo disc threatened us with extinction. Then, in 1959 at the Chicago Parts Show, a new concept in tape recording versatility—four-track stereo developed before the master tape from the recording studio to the tape in the living room. A tool of astonishing versatility, tape in other fields continues to charm old admirers and, at the same time, win new ones. Recently someone listed 207 uses for tape.

While its most dramatic use is probably in the exploration of space, the greatest number of its uses has been uncovered in the field of education, where teachers in the U.S. and overseas use it as a highly effective and important teaching aid. The Peace Corps and the military, too, have discovered its value in teaching languages. It is indeed a long list that includes not only musical instruction and speech games, but job applications and reportorial interviews.

It is the distributor that is certain to grow in this decade which we look forward to sharing with AUDIO.

K. L. (Ken) Bishop, President

RIAA

Sir:
Let me first extend the congratulations of the Record Industry Association of America, Inc. on the celebration of Audio magazine of its fifteenth anniversary.

These fifteen years have seen your publication, as well as the record and high fidelity industries, all come of age. Some of the most significant contributions to the art of sound reproduction have come to pass that period.

It is a period that has seen the development of the long-playing record, stereo sound, tape recording, FM stereo radio, and a mass market for good high fidelity sound. It is a combination of these factors that made possible the growth of the record industry from a sales volume of $204 million in 1947 to around $500 million in 1961. In that same period of a little more than a decade the record industry has also grown numerically from about a dozen to several hundred important record producers. The phonograph and audio component fields have also shown tremendous growth.

Looking back over the last fifteen years I think that both you and our industry can properly feel a sense of pride and accomplishment in the contributions that we have made toward the spread of awareness and enjoyment of good music and good sound in this country.

HENRY BRIEF, Executive Secretary

revue du SON

Sir:
MAY 1947—MAY 1962, AUDIO, which first became our guide as AUDIO ENGINEERING, celebrates its fifteenth anniversary, and demonstrates for the fifteenth time the annual proof that it has not such a wild idea to believe in the success of a technical magazine devoted to everything that can be logically placed in the category of "high fidelity."

La revue du SON is happy and proud to

(Continued on page 4)

AUDIO • MAY, 1962
You may be wondering, for example, whether the AT6's dynamically balanced tonearm will not only accept and track "professional" cartridges, but also bring out the best in them. Definitely yes! This is a counterweight balanced arm — the pressure being set in two steps. First — you move the counterweight until the arm floats at zero pressure. Then you merely move the indicator to the correct pressure shown on the built-in gauge, set on the side of the arm for easy reading. Once balanced, the AT6 arm will track each side of the stereo groove precisely and perfectly at the lowest pressure specified by the cartridge manufacturer.

Those who know tonearms will appreciate that this type of arm was once available only as a separate component. Now it is not only yours in the AT6 but integrated — scientifically mounted to insure precision performance. But that isn't all... The turntable of the AT6 is oversized, heavy, balanced. Here, too, are the features you would expect to find in separately sold turntable units — high torque, no noise, no rumble. The motor was designed specifically to match the AT6 turntable, and built by the Garrard Laboratories to deliver perfect, constant speed, silently. It is double-shielded against magnetic hum — an important feature.

Add to this such AT6 advantages as:

- (1) the convenience of automatic play, when desired (automatic and single play spindles furnished), plus the luxury of being able to intermix any size, any sequence of records. (2) Design so compact that the AT6 will fit easily into any record player cabinet. (3) Yes, if you have been wondering just how much you can expect from the AT6 Automatic Turntable at its price of $54.50, just consider these features. Better still, try one. You will be startled, and gratified, by this superb, completely up-to-date record-playing component made possible only by the unexcelled facilities and unique experience of the Garrard Laboratories.

For literature, write Dept. GE-12
Garrard Sales Corporation
Port Washington, New York

Garrard's New AT6 Automatic Turntable

How good can it be for only $54.50?

THE ANSWER: So good it will excite you!

GARRARD'S AT6 AUTOMATIC TURNTABLE

Canadian inquiries to Chas. W. Polson, Ltd., 66 Racine Road, Rexdale, Ontario — Territories other than U.S.A. and Canada to Garrard Engineering & Mfg. Co., Ltd., Swindon, Wilts., England
Although there have been interesting changes in the audio field since the inception of "Audioniclinic" in November, 1955, there is one area which does not change.

At that time, most of the music systems described by my correspondents were monophonic units—known then as monaural systems. Stereo records were not then in common use although there were some stereo recorded tapes—known as pre-recorded tapes.

Obviously, then, the majority of requests for advice addressed to "Audioniclinic" were concerned with the components which comprised "monaural" systems and the uses of each. (1962 readers who are just developing their knowledge of sound ask essentially the same questions.)

During and since the transition to stereo discs, 4-track recorded tapes and films, multiplex broadcasting, the nature of the information requested of "Audioniclinic" has changed. Today most questions deal with stereo and the techniques by which stereo is reproduced, together with requests for information about specific work each component performs in a stereo system.

The other regulars on the staff of Audio go into these topics in greater detail, and I shall not do so here. Rather, I think there are other points which should be mentioned which more specifically relate to "Audioniclinic."

True, there have been changes in the art of reproducing high-fidelity sound, but there is one basic similarity about Audio readers which does not, and will not, change: the avid interest in good sound reproduction. This element is common to all of you, whether you are a "do-it-yourself" enthusiast who wants to experiment, or a music listener who simply wants the optimum performance from existing components.

From the very beginning of this column, I have received many letters prefaced by the statement that the questions being asked are probably stupid, but would I answer them anyway. An analysis of these letters shows that they are not at all stupid but rather well-phrased and intelligent questions. They reflect only a lack of background in the field of sound reproduction. However, to gain this background, it is really necessary to probe into the subject—and the quickest way to probe is to ask questions of someone who has more understanding of the subject than themselves.

Answering this kind of letter is just as important as answering letters from those who are well-informed and wish more subtle types of information. Whatever you do, keep on writing. "Audioniclinic" wants to help you by answering your questions.

Many of the letters received by "Audioniclinic" have expressed confidence in the "Audioclinic." These criticisms have usually been of a helpful nature and have been so received. The readers who were thoughtful enough to send them to me know my sincere feelings as expressed to them personally by letter.

Therefore, please keep your questions, suggestions, and comments coming; they are all important to me in making "Audioniclinic" serve you better in the years ahead.

As many of you know, I acknowledge all mail, regardless of its suitability for use in "Audioniclinic." Often the mail bag is very heavy. When that happens, it takes a while to get around to all who have written. I want to take this opportunity to thank you for your patience while waiting for an answer to your letter.

Remy Lafaurie, Editor-in-Chief

Audio • May, 1962
How to keep your head in 4-track stereo!

EXCLUSIVE SILICONE LUBRICATION IN SCOTCH® BRAND RECORDING TAPES PROTECTS HEADS, EXTENDS TAPE LIFE!

When abrasion can actually wear away frequency response, as shown above, today’s delicate 4-track recorder heads deserve tender care. They deserve the exclusive protection of Silicone lubrication that’s available only in “SCOTCH” BRAND Recording Tapes and lasts the lifetime of the tape.

Silicone lubrication not only protects against wear—it extends tape life, eliminates chance of squeal by assuring smooth tape travel! Silicone lubrication is impregnated throughout the oxide coating of all “SCOTCH” Recording Tapes. It’s completely clean and dry—nothing gummy to attract rust or clog head gap.

This built-in lubrication is one of many reasons why professionals and discriminating home recordists alike insist on “SCOTCH” Recording Tapes. High-potency oxides make possible thinner, more flexible coatings that ensure intimate head-to-tape contact for maximum frequency response, wide dynamic range, sharp resolution. Precise backing and coating thicknesses assure identical recording properties inch after inch, reel after reel. So to help ensure the lasting fine sound of your equipment (4, 2 or full track) we suggest you play the favorite... “SCOTCH” BRAND!

For free descriptive literature, write Magnetic Products Division, Dept. MCT-52, 3M Company, St. Paul 1, Minn.

Magnetic Products Division

"SCOTCH" and the plaid design are registered trademarks of Minnesota Mining & Manufacturing Co., St. Paul 1, Minn.
The Master 10M Series is a special range of selected tubes, ideal for today's technically-advanced and exacting electronic equipment.

- Each tube Individually Laboratory-Tested
- Tube-to-Tube Uniformity and Section-to-Section Uniformity Assured
- Guaranteed Performance
- Long Life

The Master 10M Series... guaranteed for 10,000 hours of effective performance, within two years from date of purchase... now available from 10M distributors or write direct for literature.

The State of the Art
NORMAN H. CROWHURST

The last fifteen years have seen many changes in audio circuitry and philosophy. The upward power (s)urge has spent itself and given place to reason; feedback went to silly extremes and has come into sensible perspective, we have had various tests go through vogues—intermodulation, square-wave, tone burst, and so on. And, on the whole, audio seems to have grown up.

Power, Power, Power

On the power question, at one time the attitude was, the more power the better. Three factors seem to have eventually got this under control: first, the observation that the extra power did not produce a commensurate improvement in performance; second, too much power could prove costly in terms of burnt-out voice coils; and third, the advent of stereo really tamed the power urge.

Before stereo (some of us can still remember that!), the hi-fi addict could only hear the more remote parts of the music by playing it louder-and louder-and louder. Now he can hear them by use of separation. This probably explains why the use of stereo channels makes the volume seem louder with less total watts in the room; a fact which enables adequate loudness to be obtained in our own room, without producing too much unwanted sound in the next block!

Fifteen years ago, the argument called "triodes vs. pentodes" was still raging bitterly—let's hope it's dead by now! Before feedback, triodes undoubtedly had it for quality, pentodes for noise. But the advent of feedback and the variety of output circuits, ultra-linear, unity-coupled (both kinds) with their permutations and combinations, have changed all that. Nowadays everyone recognizes that the pentode is much more efficient too, and you can take your choice of circuit, according to exactly what you want from it.

Feedback

Feedback was at first seized as a cure-all. At the very first, not much was used, because the phase shift of early amplifiers would not allow more than a very few db. Then came "phase compensation," with a picofarad here and a picofarad there, enabling feedback to be...

(Continued on page 88)
AKG SALUTES AUDIO

TWINS IN AGE, TWINS IN IDEALS

For a decade and a half AUDIO and AKG have striven, each in our own way, for ever-higher standards in the re-creation of sound. AUDIO has created in the United States an informed market, ready to welcome each new advance. AKG, uniting the talents of Europe’s most progressive acoustical engineers and musicians, has consistently contributed the most meaningful advances in microphones and headphones. Unique in their variety and quality, AKG products have been welcomed warmly by broadcast, recording, and acoustical engineers, and by perceptive amateurs, the world around.

Let’s see what AKG of VIENNA means by QUALITY:

Take one of their medium-price microphones, like the D 19 B. This dynamic directional unit has a range of 40 to 16,000 c/s, and a music/speech switch. The front-to-back-sensitivity ratio of at least 15 dB extends well down into the bass, where it’s needed most. Baffling of stray magnetic fields is 18 dB. Available for 60 or 200, or 200/Hi, Ohms. Sounds good in print? Well, in use it’s even better – far beyond its modest basic price of $52!

DESIGN is based on a backlog of patents, practical experience in electronics and acoustics, engineering, and creative thinking – as in the fabulous $900 C 24.

MATERIALS include the noble metals and alloys, and stable plastics, selected for function and life, again as in C 24.

APPEARANCE shows quality – in the trim, well proportioned shape (3¾” x 1½”), and sturdy elegance of the finish.

Now, how deep does this quality go?

First, feel the solidity and balance. Then note the Serial Number. This number means that, back at the factory (just as for every other AKG product from $27 to $900) there’s an individual response curve and inspection report on the personality of this D 19 B. (Your curve is available at a slight charge).

FABRICATION is strictly one-by-one. The housing is machined; sensitive elements are shock-mounted. The diaphragm is individually centered by machine screws. The whole AKG factory is a “white area”. Quality control is strict and continuous from drawing board and raw materials to the final dog-tag performance test and packing.

PERFORMANCE? Just plug it in and hear for yourself. Built for 20,000 hours of service, D 19 B can be depended on for years to come.

For details of other AKG products, see your
80 Danbury Road, Wilton, Connecticut.

Dealer or write to Electronic Applications, Inc.,
Or phone us at (203) Porter 2-5537.

In Canada: Eberdt Co., Montreal; McCurdy Radio, Toronto

AUDIO • MAY, 1962
FIFTEEN LIGHT YEARS

It takes an anniversary with a good round figure to really shake loose memories of the past years to sound. In retracing the audio developments of the past decade-and-a-half in the field of light entertainment, I found myself stopping at many unexpected places in the road. In my record and tape library covering those years, most of the surprises cropped up when I dug out material that had never been played on my current equipment. The old 78-rpm discs had little to offer that was new to the ear, during the past five years I had occasionally used a venerable yet reasonably compliant pickup to transfer most of the valued items to 7½ ips tape. The interesting discoveries materialized in the LP discs of the late Forties and early Fifties when I played them with a modern mono cartridge.

In these days of bulging record catalogs, it's amazing to recall how little the early reader of 1940 had to work with in commercials releases to nineteen years ago, the 78-rpm record was reaching its climax in the classical field (thanks, in large part, to the efforts of London gramophones) but the popular and show albums of that day were raising few temperatures. Those record fans whose heads were in good enough condition, found an element of glamour in patronizing the import shops. A beautifully made HMV 78 by a little-known chap named George Melachrino was a typical prize. Heard on today's equipment, most import items sound still impressively flat and clean with their far from inconsiderable range.

At the same time, another small handful of domestic labels found it hard to believe that anyone could be seriously interested in the audio quality of their product. It took the development of the long-play microgroove disc in the late Forties to open the door to new labels that was new to the ear; during the past five years I had occasionally used a venerable yet reasonably compliant pickup to transfer most of the valued items to 7½ ips tape. The interesting discoveries materialized in the LP discs of the late Forties and early Fifties when I played them with a modern mono cartridge.

W

When you consider the wealth of recorded material that was to tumble from the industry, it's rather difficult to believe how much of the audiofana was in 1950. To take just one example, the Schwann catalog of that year contained only one "sound" record. That was "Stethoscopic Heartbeats" on Columbia ML 4240. There were sound effect libraries still in existence but these were not available to the general public at the corner record shop. As a matter of fact, you had to be pretty creative to find the Columbia heartbeats record because it was listed under "Miscellaneous Collections—Classical." A few years later a sound fan could consult an enlarged copy of the same catalog and find that three other sound records had joined the heartbeats—the entire group carefully filed in the Spoken and Miscellaneous section of "Miscellaneous Collections." The monthly catalogs of the 1950's still reflected the influence of the 78-rpm record. Many albums of light music were transfers from 78's. Virtually all of the albums were issued on 10-inch LP. Bing Crosby dominated the scene with twenty-five albums. (The total number of his albums was to reach fifty by 1952.) Al Jolson, almost forgotten by the present generation of record buyers, had five albums on the market in 1950. In mood music, Paul Weston was deeply entrenched with his "sweeping strings" arrangement of "Chromatic"—first as a single, then as part of an album.

The ten-inch format then prevalent in the trade undoubtedly had a lot to do with the solid success of light music on microgroove. In pre-discount days, prominent labels such as Capitol, Columbia, Decca, Mercury, and M-G-M were available at $2.85, RCA Victor and Vox sold their ten inchers at $3.85 while London Records in the early years were, and still are, models of that type of recording. For true presence on closer up, the original "Broadway East" album was already top dog in earnings in the light field. The big surprise, to no one's surprise, were available only on twelve-inch disc.

Two of the early deluxe sets offered Broadway plays on the Decca label at $11.70—"Death of a Salesman" and T. S. Eliot's "Cocktail Party." "South Pacific" and "Kiss Me Kate" were riding high and pulling up the staterooms. I resisted the temptation to blame the recording.

Looking back at the roster of labels active during that year, perhaps the most remarkable name missing from the list is that of Emery Cook. During the Fall of 1950, Cook was busy prowling the yards and trashpits of the New York Central and the Manhattan streetcar system with his recording equipment and a gleam in his eye that probably went unnoticed by the train crews with whom he came to contact. And in December he finished his rounds, appointed and otherwise, Cook had a recording task that was to shake most of the recording industry out of any hard-earned dreams that start the high-fidelity era we still have with us today. His ten-inch disc called "Rail Dynamics" was the first self-distributed sound recording to meet, and in some instances exceed, the specifications of the higher-priced sound components then on the market. Most of us realized at the time that the record industry as a whole was in for a shock. Cook's release was, of a 'carryover effect,' the most impressive one today is the fabulous impact of steam transients recorded at very close range. Other mono Cook/ Columbia releases of Our Times volumes in my collection, many of them now out of print, sound as good or better than mono discs that came out ten years later. For example, "Music Boxes of Long Ago" (Cook 1016) still refers to in range and clarity anything else on the subject in the catalog today. The Carlos Montoya, Flower, sounds were, and still are, models of that type of recording. For true presence on closeup, the original "Broadway East" album was already top dog in earnings in the light field.

Don’t buy it just because it’s the world’s best seller.

(There are 7 better reasons for choosing the Fisher 500-B integrated stereo receiver.)

1. All-in-one design: FM Stereo Multiplex tuner, stereo control-preamplifier and stereo power amplifier, all on one superb chassis, only 13 1/2" deep by 17 1/2" wide by 5 1/4" high. Just connect a pair of speakers and it’s ready to play!

2. Ultrasophisticated wide-band FM Multiplex circuitry, with 0.7 microvolts sensitivity for 20 db quieting at 72 ohms (2.2 microvolts IHFM Standard), four IF stages, absolute stability.

3. Exclusive Stereo Beam indicator, the ingenious Fisher invention that shows instantly whether or not an FM station is broadcasting in stereo.

4. High undistorted audio power: 65 watts IHFM Standard stereo music power at less than 0.8% distortion.

5. Master control-preamplifier section of grand-organ versatility and simplicity.

6. Magnificent styling, with architectural brass-finish control panel and beautifully finished walnut or mahogany cabinet.*

7. The Fisher name. (No comment necessary.)

Price, $359.50.* The Fisher 800-B, virtually identical but also including a high-sensitivity AM tuner, $429.50.*


Fisher Radio Corporation
21-29 44th Drive
Long Island City 1, N. Y.

Please send free 40-page Handbook, with complete specifications on the 500-B and 800-B.

Name __________________________
Address _________________________
City ________ Zone ______ State ______

FISHER
HANDBOOK

1962

Fisher Radio Corporation
21-29 44th Drive
Long Island City 1, N. Y.
Please send free 40-page Handbook, with complete specifications on the 500-B and 800-B.

Name __________________________
Address _________________________
City ________ Zone ______ State ______

Audio • May, 1962

9
Push a button and away you go! Up to sixteen hours of play at 1 3/4 ips. You may need a few fingers to flip a switch or turn a reel over but that's all it takes to enjoy the Luxor Magnefon. This handcrafted Swedish stereo tape recorder is designed for simple trouble free operation whether you use it for recording Handel in stereo multiplex or Junior monaurally. If the best Audio dealer in your village doesn't handle this electronic gem... he isn't... and in that event see another dealer. He is on the way up! p.s. don't pay more than $289. for it... and you can shave $10.00 by moving east of the rockies.

THE MAGNEFON BY
LUXOR
MOTALA, SWEDEN

Please write for illustrated descriptive brochure
AmerLux Electronics Corporation
60 East 42 Street • New York 17, N.Y.

NAME
ADDRESS
CITY
STATE

its mikes, amplifiers and cutters. Cook was not the only label nudging the big outfits in the early Fifties. Peter Barlow, Vanguard, Westminster, Montilla, EMS, Ese- toric, and Mercury were labels doing excellent pioneer work but most of their efforts were devoted to classical music. All of these companies were active in 1953 but in the Spring of that year only one label was competing with Cook in the production of sounds on records. That outfit was Folk- ways. Its two releases, "Sounds of the South American Rain Forest" (X-120) and "Sounds of the Sea" (X-121), had the distinction of being the most expensive twelve-inch releases on the market at $6.95 a disc. It is true that ingredients of more than average expense went into the production of these pressings but the price was also based on the assumption that the owner of a high-performance sound system would be willing to pay that price for unusual program material; and pay it he did.

An even more expensive proposition was set before the record buyer when Emory Cook introduced his version of the stereo record in the early Fifties. Called "binaural" records by some, these discs had half the playing time of conventional mono records because channel A occupied half of the record and channel B the other half. The two mono pickups (invariably Pickering whenever Cook demonstrated the system) were mounted on a dual arm that engaged the two bands simultaneously. This technique offered all the separation you wanted in the full range of sound then available on mono discs. The Achilles heel of the system, however, turned out to be something that was quite unrelated to the cost in terms of playing time per record side.

When I began a program series for audiofans on WQXR in the autumn of 1953, one of my FM-AM stereo broadcasts was devoted to an hour of Cook dual-band stereo records. I never expect to live through a more harrowing hour than that one in two-channel broadcasting. On the afternoon of the broadcast, Emory Cook brought down from Stamford, Conn. the table and dual arm he had been using in his demonstrations. Whatever shaking the unit took in the trip to New York so unnerved the two arms that Emory himself could get the bands to synchronize only on every third try or so—hardly a good batting average for air work. The studio engi- neer rehearsed those two arms for several hours before air time and then managed to broadcast all six records successfully by patiently cueing and recueing each pair of bands until they were working in unison. At the end of the broadcast the man was a shambles and Emory possibly had begun to entertain his first doubts about the future of dual-arm stereo.

In comparison, two-track stereo tapes, when they came along a few years later, seemed like child's play. Channel balance and distortion varied from one release to another but the process itself was manageable. The 7 1/2-ips two-track product, when played with heads of a relatively wide gap then in use, did not have the treble response we were accustomed to on the better-quality mono discs. The early duplicating process did not lead to the standards of quality control then possible in the manufacture of discs. As usual, the lighter releases on two-track stereo tape escaped the problem that has always plagued classical recordings. Background noise on popular music tapes did not crop up the way it

(Continued on page 86)
Summing up his report for HI-FI STEREO REVIEW, Julian D. Hirsch wrote: "In my opinion, the UNIVERSITY CLASSIC MARK II... is one of a limited group of speakers to which I would give an unqualified topnotch rating."

"Despite the popularity of bookshelf-size speaker systems, the big speaker system is far from extinct. There is still a great deal to be said for the sound quality of a really good large speaker system, one of which is University's new Classic Mark II.

In operation, the Classic Mark II handles low frequencies up to 150 cps through a 15-inch high-compliance woofer that is installed in a ducted-port cabinet. The bulk of musical program content, however, is handled by an 8-inch mid-range speaker, which covers from 150 to 3,000 cps. Above 3,000 cps, a Spheric on super tweeter takes over.

The measured indoor frequency response of the Classic Mark II was remarkably uniform. As a rule, such response curves are so far from flat that I do not attempt to correct them for the slight irregularities of the microphone's response. However, the measurements for the Classic Mark II prompted me to plot the microphone response also. This further emphasizes the uniformity of the system's frequency response. A 5-db increase in the setting of the tweeter-level control would probably have brought the range above 3,000 cps into nearly exact conformity with the microphone-calibration curve.

The low-frequency distortion of the woofer, even at a 10-watt input level, was very low, and it actually decreased at 20 cps, where the output was beginning to rise... Any good amplifier of 10 watts rating or better should be able to drive it satisfactorily.

In listening tests, the Classic Mark II sounded very clean... there was an undercurrent of bass, more often felt than heard, that was completely lacking in some other quite good speaker systems that I compared to the Classic Mark II. The speaker sounded at its best (to my ears) at moderate listening levels. At high levels the bass tended to be overpowering. A different listening room, of course, could easily alter this situation completely. Over-all, the sound was beautifully balanced, with wide dispersion and a feeling of exceptional ease. There was never a hint that three separate speakers were operating; the sound seemed to emanate from a large, unified source.

In my opinion the University Classic Mark II justifies the substantial claims that its manufacturer has made for it. It is one of a limited group of speakers to which I would give an unqualified topnotch rating. Anyone who is in a position to consider a system of its size and price would be well advised to hear it. The price of the system is $295.00."

WRITE TODAY FOR THE COMPLETE JULIAN HIRSCH HI-FI STEREO REVIEW REPORT on the new CLASSIC, as well as the documented CLASSIC brochure and "Informal Guide to Component Stereo High Fidelity." Simply write: Desk R-5, UNIVERSITY Loudspeakers, 80 S. Kensico Ave., White Plains, New York.
THE REVOLVING ANNIVERSARY—OUR FIFTH IN RECORDS

Instead of concentrating on our 15th Annive rsary, which we seem to have neglected editorially—En.

Banner Year

As I look back on that Fifth Anniversary year, I'm amazed—it was a time of feverish activity in the entire sound world with hi-fi just one of its many aspects, just about ready to burst wide open. It was a time when developments came faster than you could keep track, when controversies raged with enthusiasm over matters now long since settled and forgotten. It was, that year, a time of change, of looking out at me hopefully—"will I do invence discs, wasn't there. Natch. (If stereo LP (played mono for a more objec the old records sounded, what they had in common, as of 1952, how they differed collectively from our present output. Several times, just to see, I put on a brand new stereo LP (played mono for a more objec compared to the original LP. Its highs were sharper than ours and they must be reduced more than the RIAA position allows, or the sound will be strident. And it was a year (almost literally—it had a reverse twist); but that is less important for the ear. All Columbia LP records were reviewed in this position and, equally important, all of the many small-label records then being pressed by Columbia, Westminster, for instance, V. T. & T. Plenty more. Almost a standard.

But RCA, of course, was as different as it could manage to be. No self-respecting Louisville, one of these were actually quite a bit on a Columbia equalization! Other disc curves fell but vaguely into the RCA camp, though one could never be sure. And London LP went on its own and equiva ence of quality, not music. Music is not quite as changeable as audio. Musical changes in ten years are significant, but I honestly found that the sound and characters are typical of every one of us who made or played a record! Or made a hi-fi amplificatio Unbelievable, and all because the gentlemen of the record industry had a better of honest but violent differences as to how a record ought to be made and, subsequently, played.

Everybody had his own curve (and half of them didn't tell you what it was, either—if they knew themselves!). Every hi-fi man had his equalizer. Half of his time was spent figuring out some wild and woolly guesses, too! And so, to my pleasure, I've found someC_CALCED !5 discs in my 1952 reviews. And so in 1952. A "jiggered up" 1952 LP record will play rightly good 1952 PHONOGRAM, was there. Notch. (If you borrowed it, kindly return at once.) But 50000, one of the very first group, could stand in for it very well. And I quickly found myself trying to pin down how these old records sounded, what they had in com generally more "colored" than now, on the average. And so, to my pleasure, I've found some outstandingly "clean" discs in my 1952 explorations—as played on 1962 equipmen but also some disturbingly unclean ones. My estimates of them in 1952 are sometimes a trifle off, We were more tolerant of distortion then, simply because we heard it so much of the time, hi-fi claims or no. After all, have we been standing still these ten long years, and? I found one interesting and unexpe ted phenomenon in these old records. A "clean" 1953 style record, as now played, that was able to take a high (or bass) boost (as well as a cut) without showing undue unpleasantness. It is thus quite easy to get good sound out of these clean older discs in spite of the unstandard equalization. Just swing your tone controls around until a natural sound emerges. The record will not be demanding, the low easily surprising. 

The flexibility of recorded sound under such an equalization treatment is a good outward indication of its total cleanliness. On the other hand, a "jiggered" curve, sound, peaked and rolled, turns out now to be strangely resistant to any equalization on modern equipment. Odd! There were plenty of records in those days, and a lot of them were jiggered deliberately for effect, as I know very well, having seen it actually happening in some very high places. Also from first-hand contacts with some of those who had to do it for their respective bosses. (Now, it's the tricks of reborn and who's in the business today.) Other records were jiggered by accident, thanks to inadequate equipment, or for unskilled use of it all along the line.
A great tape recorder made greater:

1. New professional studio recording hysteresis-synchronous capstan motor: 24 stator slots for ultra-smooth drive, ultra-quiet and vibrationless professional bearing system.

2. Two new take-up and rewind reel motors, both extra-powered for effortless operation.

3. New core-dout steel capstan flywheel with all the mass concentrated at the rim for improved flutter filtering.

4. New optimally designed capstan drive belt brings wow down to negligibility.

5. New relay provides instantaneous extra power to the take-up reel motor at start to minimize tape bounce. Provides near-perfect stop-and-go operation and eliminates any risk of tape spillage when starting with a nearly full take-up reel.

6. New automatic end-of-tape stop switch cuts off take-up reel motor power. Also permits professional editing techniques, whereby tape being edited out runs off the machine while you are listening to it.

7. Playback preamps remain on during stop-standby mode to permit cueing.

8. Recording level adjustment during stop-standby.

9. Shock-absorbent helical spring tape lifters practically eliminate tape bounce at start of fast winding.

And All These Well-known RP-100 Features:

Separate stereo 1/4 track record and playback heads permitting off-the-tape monitor and true sound-on-sound recording; separate transformer stereo record and stereo playback amplifiers meeting true high fidelity standards; monaural recording on 4 tracks; digital turns counter; electrodynamic braking (no mechanical brakes to wear out or loosen); all-electric push-button transport control (separate solenoids actuate pinch-roller and tape lifters); unequalled electronic control facilities such as mixing mic and line controls, two recording level meters, sound-on-sound recording selected on panel, playback mode selector, etc. Modular plug-in construction.

Wow and flutter: under 0.15% RMS at 7 1/2 ips; under 0.2% RMS at 3 3/4 Ips. Timing Accuracy: ± 0.158% (23 seconds in 30 minutes). Frequency Response: ± 2 db 30-10,000 cps at 3 3/4 Ips, 55db signal-to-noise ratio; ± 2 db 30-10,000 cps at 3 3/4 Ips, 50db signal-to-noise ratio. Line Inputs Sensitivity: 100mv. Mike Inputs Sensitivity: 0.5mv.

The MX-99 employs the EICO-originated method of zero phase-shift filterless detection of FM Stereo signals (patent pending) described in the January 1962 issue of AUDIO Magazine (reprints available). This method prevents loss of channel separation due to phase shift of the L–R sub-channel before detection and matrixing with the L+R channel signal. In addition, the oscillator synchronizing circuit is phase-locked at all amplitudes of incoming 19kc pilot carrier, as well as extremely sensitive for fringe-area reception. This circuit also operates a neon lamp indicator, whenever pilot carrier is present, to indicate that a stereo program is in progress. The type of detection employed inherently prevents SCA background music interference or any significant amount of 38kc carrier from appearing in the output. However, very sharp L-C low pass filters are provided in the cathode-follower audio output circuit to reduce to practical extinction any 19kc pilot carrier, any slight amounts of 38kc sub-carrier or harmonics thereof, and any undesired detection products. This can prove very important when tape recording stereo broadcasts. The MX-99 is self-powered and is completely factory pre-aligned. A very high quality printed board is provided to assure laboratory performance from every kit. The MX-99 is designed for all EICO FM equipment (ST96, HFT90, HFT92) and component quality, wide-band FM equipment.

The MX-99 is designed for all EICO FM equipment (ST96, HFT90, HFT92) and component quality, wide-band FM equipment.
The Dual-1006 Custom

We consider the Dual-1006 CUSTOM to compare more than favorably with any other record player now on the market. So much so that we submitted it for testing to a completely impartial authority. A copy of this report is now available upon request. It contains the facts to be familiar with before considering any purchase of record playing equipment. For your copy write: Dept. C-5.

united Audio

THE WORLD'S FIRST (AND STILL THE FINEST) AUTOMATIC/ MANUAL TURNTABLE TURNTABLE

& RECORD CHANGER!

The Hollow Sound

Equalization aside, the most striking aspect of these 1952 type records was the acoustical quality of their sound, whether distorted or not. How mightily have we changed! How drastically different is our current mike technique and its new-fangled adjuncts in mixing and reverberating!

Nowadays, it's all reverberation. In 1952, though halls were as reverberant as they are today and many recordings were made in the very same places they are now, ten years later, the recorded effect is surprisingly different. I used to think that the old and dignified pre-war 78 classics were the real "dead" recordings; now, in 1962, I see that in comparison to today's new sound, the 1952 norm was relatively close to that of the pre-war period. It was generally not as dead. But it shared a certain abrupt, unreverberant spatial effect that, to my astonishment, I now find quite objectionable. Obviously, I was wholly unaware of it in 1952. My own printed remarks say so.

You see, it isn't only an increase in recorded reverberation, though that is a big element in the change. The present sound, born of the stereo age, is immensely full-bottomed and large-bodied. Perhaps artificial reverb, added in various ways, makes the difference; but I suspect the new multi-mike stereo techniques have a lot to do with it. (In 1952 Mercury used a single microphone for its Olympian Living Presence series, launched that year. Now the company uses "only" three mikes for its stereo Living Presence.) Yet even the dual-mike (one-point or cross-mike) European techniques now manage to get a good deal of the "new sound" quality into today's discs. There's more to it.

There is no single factor. No two recording engineers will agree, indeed, as to what these subtle differences involve, nor what is the proper procedure for producing today's optimum recording. Each has his mixing secrets, as always. And yet, by golly, you can spot a 1952-period recorded sound quite easily; it is as much like its neighbors on other discs as a 1952 Plymouth resembles a '52 Ford.

Anyhow, these older records for my 1962 ears rather strikingly lack some mystically active kind of presence and aliveness that our mike artists know how to achieve—and this quite over and above their varying lack of tonal purity. The older sound is somehow hollow to me. That is, the spaces in which the music is heard are unimpressive, even with a properly longish reverb time. They seem pinched, confined, smallish in impact, belying their actual size. Carnegie Hall is smaller than life, not larger. It isn't spread out in my room, before me; it is heard through a hole in the wall, and the hole isn't big enough, even via two stereo loudspeakers playing in mono.

I find remarkable, then, what we have managed to do today, via technical progress, via increased mike know-how and via our education. Our musical ears have been working hard along, you see, keeping up with the technical progress in recording and microphoning; we now can enjoy and interpret, in terms of musical re-creation, types of sound that in 1952 (not to mention 1947!) would have been ugly and semimeaningless to most of us. I suggest that in this teaming-up of ears and technology we are now able to make a lot more illusion out of what we have to work with. Our music is bigger, fuller, richer, more immediate to us, whether the instruments are

(Continued on page 76)
TRIPLE TREAT SPECIAL

ONE FULL HOUR OF PRE-RECORDED 4-TRACK STEREO MUSICAL ENTERTAINMENT

Silk Satin and Strings
Jalousie
Laura
Falling in Love
From This Moment On
Holiday for Strings
Sleepy Lagoon
It's All Right With Me
Stella by Starlight
Out of My Dreams
El Cholo
Blues in The Night
Jazz Pizzicato

Gigi
Title Song
Waltz at Maxim's
Thank Heaven for Little Girls
The Parisians
I Remember It Well
The Night They Invented Champagne
Reprise: Gigi

My Fair Lady
On the Street Where You Live
I've Grown Accustomed to Her Face
With a Little Bit of Luck
I Could Have Danced All Night
The Rain in Spain
Wouldn't It Be Loverly
Show Me

★ Original Broadway arrangements of 13 top tunes from both “Gigi” and “My Fair Lady,” re-creating the sparkle of opening night for thirty entertaining minutes

★ PLUS “Silk Satin and Strings,” a half-hour of all-time favorites including “Blues in The Night,” “Holiday for Strings,” and ten more memorable melodies...two current catalog albums (Concertapes No. 4T-4001, $7.95, and No. 4T-3006, $6.95) combined on one hour-long Tarzian Tape to give you a $14.90 value

★ PLUS a full 7-inch reel of blank Tarzian Tape, factory-sealed in protective plastic and quality-guaranteed.

This entire “Triple Treat” package is now available at leading tape dealers for only the price of two reels of blank Tarzian Tape and $1.49.

Here is music for pleasurable listening, imaginatively interpreted by Caesar Giovanni and the Radiant Velvet Orchestra in true stereo sound. It covers the entire range of popular music at its best...from the romantic “Falling in Love With Love” to the toe-tapping tempo of “The Night They Invented Champagne.” This is current catalog music, available now at a price far below the retail cost—and combined on one professional-quality Tarzian Tape to provide a full hour of musical entertainment.

As you listen, your ears will detect a wide frequency response and dynamic range: a smoothness and clarity of sound unusual even in high-fidelity stereo tapes. That's when you should unwrap the blank reel of Tarzian Tape. Use this tape to record a special FM program, or several favorite records. We'll bet that the playback will reveal the same depth and realism that you enjoyed on the studio-produced tape.

Hard to believe? That's exactly why we are making this special offer. More surely than anything we can say, your ears can prove to you that Tarzian Tape does indeed make possible a new fidelity in sound reproduction, in your home as in the professional studio.

Try it. Visit your favorite tape dealer today and get your “Triple Treat” package from Tarzian.

SARKES TARZIAN, INC.
World's Leading Manufacturers of TV and FM Tuners • Closed Circuit TV Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices

MAGNETIC TAPE DIVISION • BLOOMINGTON, INDIANA

Audio • May, 1962
EDITOR’S REVIEW

THIS MONTH’S COVER

Shown on the cover this month is a crystal lyre Audio had made for this occasion in Italy by the glass-blowing firm of Bruno Polaaco & Co. of Venice. The lyre is made of crystal to symbolize our 15th Anniversary; the crystal was made in the shape of a lyre because that is the symbol of the IHFM (Institute of High Fidelity Manufacturers). Bringing these seemingly unrelated facts together, Audio, as its contribution to this celebration, is presenting this lyre to the IHFM, an association dedicated to the furtherance of high quality sound reproduction. We are presenting the lyre because the manufacturers who constitute the Institute have been of great service to the audiofan, our readers, by consistently providing superior products and promoting the concept of component-quality sound reproduction. It could truthfully be said that very few audiofans would be experiencing high fidelity today were it not for these manufacturers.

With this token we recognize the contribution of the IHFM.

AUDIO CLUBS?

Over the past few years, at shows and other such gatherings, many audiofans have indicated to us an interest in joining with other audiofans in their locality for the purpose of comparing, sharing, and learning. "After all," one said, "fans in other fields advance their knowledge and their hobby by forming clubs, so why not audiofans?"

Well, we couldn’t answer his question for him but we did promise to help those Audio readers who wish to form a club. We’ll do it in the following way: (1) we will transmit back to a particular locality the names of those people in that area who wish to form a club; and (2) we will provide space in Audio for an exchange of ideas between local groups.

In order for us to help you here is what you must do: (1) write to us; and (2) indicate whether you are willing to act as a central point in your area until the club is formed.

FACES

You will notice that we have provided new column headings for most of our regular staff features—the basic difference being the inclusion of a line drawing of the columnist. To round out the “picture” we present below photographs of the Publisher and the Editor. (Aren’t anamorphic lenses wonderful?)
At Last!
A CARTRIDGE DESIGNED ESPECIALLY FOR AUTOMATIC TURNTABLES!

The Pickering Model U38/AT is a cartridge designed especially for the new generation of automatic turntables. A true STANTON Stereo Fluxvalve, it combines excellent hum shielding with high output for unequalled signal-to-noise ratio.

High compliance is provided for the special turntable features while preserving the ruggedness demanded by automatic operation. Improved frequency response and lower inductance make the new Pickering U38/AT a truly universal cartridge to match the universal features of the automatic turntable.

TECHNICANA: Pickering Model U38/AT is a STANTON Stereo Fluxvalve with a white body and black V-GUARD stylus assembly. Weight is 14 grams; mounting centers: 7/16" to 1/2". Supplied with universal mounting hardware. $46.50 AUDIOPHILE NET

RESPONSE: ± 2 db from 20 to 20,000 cycles.

CHANNEL SEPARATION: 35 db

OUTPUT: 10 mv each channel

TRACKING FORCE: 2 to 5 grams

IMPEDANCE: 47,000 to 100,000 ohms

SHIELDING: Complete mu-metal.

FOR THOSE WHO CAN HEAR THE DIFFERENCE

PICKERING & COMPANY, INC., Plainview, N. Y.

The hermetically sealed STANTON Stereo Fluxvalve is warranted for a lifetime and is covered under the following patents: U.S. Patent No. 2,917,590; Great Britain No. 783,372; Commonwealth of Canada No. 605,673; Japan No. 261,203; and other patents are pending throughout the world.
50,000,000 tube hours...
an unusual electron tube
still keeps undersea
voice signals strong

Deep on ocean floors, from North America to Europe, between Key West and Havana, Florida and Puerto Rico, under the Pacific to Hawaii and Alaska—in 20,000 miles of undersea telephone cable—a special kind of electron tube is setting a remarkable record for reliability.

This four-inch-long electron tube was designed, developed and fabricated at Bell Telephone Laboratories to operate with no attention for 20 years or more. It is part of the submarine cable repeater manufactured by Western Electric which faithfully and reliably amplifies voice signals transmitted along undersea coaxial cables.

All of the 1608 tubes built into the repeaters have operated to date without failure for a total of over 50,000,000 tube hours, or an average of three-and-a-half years. The oldest have been in service since the first deep-sea repeatered telephone cable was laid 12 years ago.

Years before it was put to use, Bell Laboratories scientists and engineers began developing this undersea tube, another example of forward-looking technology that has made the Bell Telephone Laboratories the world center of communications research and development.

BELL TELEPHONE LABORATORIES
The history of AUDIO is closely tied up with that of the whole high fidelity industry—and we even started first. But as long as there is hi-fi, there also will be a dedicated staff who have labored long and hard to keep ahead of the field.

The year is 1947. High fidelity is a limited hobby enjoyed by a few dedicated individuals who may have had contact with the professional aspects of sound reproduction and who couldn't enjoy coming home to what passed for radio and phonograph reproduction as exemplified by the then available equipment. To make sure of having a good amplifier, one had to scrounge one from a broadcast station or the local movie house. The same sources were constantly searched for loudspeakers which would recreate music to satisfy the critical listener.

In contrast to most hobbies, there was no common meeting-ground wherein Paul from Boston could exchange ideas with Harry in Dallas or Marty in San Diego. Neither could the music lover in Miami communicate with his counterpart in Upperplate, Wyoming.

Then came AUDIO ENGINEERING—the first magazine devoted to the sound engineer, ostensibly, but with a strong feeling for the problems of the audiophan who might be a surgeon, dentist, accountant, or college student during the major part of his day. To be sure, it was quite technical in its first years—and many of the earlier readers express a desire that we should go back to them—but with the growth of the Audio Engineering Society and the emergence of its Journal, the highly technical articles have a place for publication for a relatively small membership, while AUDIO strives to furnish good reading, accurate technical information, and general help to the striving audiophan.

The first issue of AUDIO ENGINEERING, May, 1947, showed Norman Pickering on its cover, reproduced in Fig. 1, with his then new low-stylus-force, high-compliance magnetic pickup which appeared in cartridge form a few months later as the first magnetic pickup of professional quality intended for home use. The second issue, Fig. 3, showed an RCA Master Sound Console on the cover and carried a descriptive story inside. For six months, everybody was saying, "It's a great issue, but how long can they keep it up?"

Figure 4 shows more covers from '47 and '48—the first with one of the first published photos of an anechoic chamber and the remainder devoted to master and studio control facilities of radio stations.

For almost two years the AUDIO tradition grew under the editorship of John H. Potts. Fig. 2, who died on March 16, 1949. After his death the trend toward the audiophan grew more rapidly, in step with the trend toward more equipment intended for home use and offered by a small handful of manufacturers.

Since there was then relatively little commercially available equipment except that made for broadcast stations and other professional users, it had a strong leaning toward the do-it-yourselfer. Scores of articles describing home-built amplifiers graced the pages of it over those early years—but always tucked in among the more serious articles. The popularization of the Williamson amplifier in the U.S. dates from November, 1949, when the story of the "Musician's Amplifier" was published. The Ultra-Linear circuit was first brought to the public eye by Dave Hafer and Herb Keroes in November, 1951.

AUDIO Firsts

Aware of the potentialities of the hi-fi field, it always endeavored to be the first to introduce any new idea. For example, the loudness control—a well compensated device which has been credited with...
having brought hi-fi out of the basement into the living room—was published in the May, 1948, issue. The same issue also told of an elaborate "echo chamber" built by KFI in Los Angeles for radio station use, and copied in various forms since then for home reverberation devices.

The first "feeling out" of readership on the subject of an Audio Engineering Society was in the form of a "planted" letter early in 1948, resulting in the formation of the Society later that same year—and JE was represented on the steering Committee that did all the early work, and later on the Board of Governors and finally as President.

The back-loaded corner speaker was first introduced in JE in the January and February issues of 1949—and many commercial speakers followed the design in varying degrees of imitation. And later in 1949 the first exhibit of audio equipment was planned at JE and the name Audio Fair was given to provide a simple title that was euphonious and easy to remember. Unfortunately the Audio Engineering Society—the sponsor of the show—did nothing to protect the proprietary rights to the name and so lost them. But even though the official name of the annual hi-fi show is now different, the old title still sticks unofficially amongst the old-timers.

Other firsts include a complete issue on stereo just at the time the multiplex story broke—a lucky accident, it later appeared. Then, too, there was the first article describing how to modify a common G-E monophonic cartridge for stereo, a number of articles about matrixing and two-channel switching and controlling, as well as others about the latest types of stereo control amplifiers. And, of course, the greatest "scoop" of all—five articles on the FCC-approved system for FM-stereo in the readers’ hands only forty days after the decision was announced—at least a full month before any other magazine published any technical details whatsoever.

Over the years the front cover of JE has gradually shifted from the professional to the home user. There was even a brief interlude of an insert "magazine within a magazine" called Video Engineering, but that was only a flash in the pan, so to speak. Figure 5 shows more covers ranging from ultrasonics to the home installation. In order to appeal more to the audiophiles, the "Engineering" was dropped from the title beginning in January, 1954, and in February a whole new cover design appeared—the one at the far right in Fig. 5. The designer of the new cover, Leo Leoni, felt that because of the diversity of subject material inside the book, the cover should show something technical and something not technical—hence the schematic along with a photo of a home installation or equipment for some months. Late in 1957 another cover design evolved which has continued up to now—but this month’s cover should not be considered another "permanent" change.

Actually, of course, the appearance
Fig. 7. Covers up to date: October, 1956, with a drawing of the action of a transistor and a circular horn loudspeaker; April, 1957, with a simple transistor circuit and another home-built speaker enclosure; January, 1958, with the first published photo of a stereo record cutter; and April, 1959, with typical hi-fi room settings.

Fig. 6. Lead photo for the first definitive Williamson article in the U.S.A., November, 1949.

of the inside of the book has not changed much over the years. We feel the reader will become accustomed to a certain style and arrangement, and would prefer it to remain reasonably constant—something familiar about each issue from mouth to mouth. Maybe some readers would prefer more variety—how does one tell without trying it out?—and then it might be too late to change back. We do strive to be accurate technically and to use consistent and correct grammar and punctuation, however. We see no reason why a semi-technical magazine should use less than correct English.

Covering the Field

The gentle art of high fidelity comprises more than equipment. Not only are amplifiers and turntables and tape recorders and loudspeakers all parts of the whole system—so also are the sources of music or sounds that are played through them. Thus from the first issue of Audio Engineering in 1947 to the present, considerable space has been devoted to record reviews. On the classical turntable is Edward Tatnall Canby, who has been the mainstay of the record reviewing staff for fifteen years and who is also fairly typical of the non-technical audiophool. He has an intense curiosity about equipment and he also has ten thumbs—as he so often says. But he is a good guinea pig for new ideas—and if they are musically good, he is one of the first to espouse them. Charlie Robertson is a jazz buff at heart—and a newspaper reporter by profession. Chet Santon is a dignified announcer over the air, and an enthusiast for the "listenable" type of music. Harold Lawrence, a record company A & R man by profession, is full of interesting side-lightson music in general. Joe Giovanelli builds his own ham equipment, repairs TV and radio sets for friends, and has for a current project the construction of a top-quality tape recorder for his own professional use. Herman Burstein is an economist when he's working and a tape hobbyist when he's not. The most recent staff contributor, Norman Crowhurst, is an engineer-turned-writer with a flair for the tutorial—his Trainers are just that.

Industry Relations

Audio recognizes its responsibility to the entire high fidelity industry. We feel that the hi-fi press should be fair to the reader in its presentation of new ideas—something different. Ideas that are just gimmicks should, in our opinion, be brushed off in keeping with their actual importance. On the other hand, the press should co-operate with manufacturers and their organizations whenever and however possible—opposing when it is believed necessary—but always offering a solid front to the public eye. If we do not always acclaim something as the greatest thing since the invention of the automobile, for example, it may be because we firmly believe it isn't. And that is our basic policy—if the reader is served honestly and well, the entire industry will benefit. And we believe also in co-operation between the members of the industry—exemplified by the Institute of High Fidelity Manufacturers. 'Way back in 1953 we proposed the formation of the Audio Council. Nothing happened then, but in 1955 the IHFM came into being. This year we proposed something else—and now we'll just wait and see what happens to that idea.

The Last Words—of the 180th issue

High fidelity is a serious hobby to those who pursue it—these audiophools put a lot of time and money and heart and soul into it, and they expect a lot of satisfaction in return. We at Audio have the same hobby, reality, and we enjoy being of whatever help we can to our fellow hobbyists. So we pledge for the next Fifteen Years to carry on in the same vein—improving whenever we can, but always trying to help the reader—and, in so doing, ourselves.
Most of us know this feeling: it strikes me with particular violence when I see a 10,000 word article on, let us say, recent advances in bio-electrical instrumentation at the Cape Horn Entomological Institute. I do not hear Whitman’s voice, but Lewis Carroll’s Bellman, exclaiming “Oh, skip your dear uncle!” If, therefore, the reader feels that

“The line too labourous and the words move slow”

I beg him to remember that I am not free to skip forty years. Nor, as it happens, is that my wish; it is rather exciting to see that the transistor is, at last or so soon, however you look at it, really breaking into the audio field. This is the Fifteenth Anniversary Issue of AUDIO: fifteen years ago there were no transistors at all. A few, a very few years ago, if you wanted more than a few milliwatts of power you had to accept quality which you would hardly accept from your telephone. Now we have at least what you may call fairly high fidelity.

This qualified approval is probably unfair. Professionally we have moved with tube amplifiers from the 1-per-cent distortion of the late thirties to the 0.1 per cent of the early fifties. In general, it seems that the transistor amplifiers have broken through the 1-per-cent barrier but have not yet made the 0.1 per cent, but this may be because it looks better to claim 20 watts at 0.5 per cent than 10 watts at 0.1 per cent. The trouble is that the men who write the brochures read Walt Whitman and they think that we do not want the proofs, the figures, the charts, the diagrams.

Probably more important than the 1-per-cent distortion figure is the breakthrough in the 3-4000-eps figure. Just how high you need to go in the frequency spectrum is anybody’s guess; the European professional standard used to be 16,000 cps for broadcast material sent over lines from one country to another. Since the problem here is to avoid international arguments about which country

lost the highs if a listener complained, that is probably a sensible and safe number to take. The new transistor amplifiers have broken right through this and are generally flat up to 20,000 cps or more.

We have, I suppose, three topics. How has it been done, who has done it and where do we go from here. It is simpler than the world of criminology, where you must ask, How, When, Where, Why, and Who, for When is now and Why is well, if you do not know why designers are at work you are very lucky.

How can be divided into two parts. Let us look at the background first. The real key to the advance in performance is the development of suitable transistors at a suitable price. The audio frequency transistor as we knew it only a few years ago just would not allow us to get high quality; the diffused-base power transistors with common emitter cut-off frequencies around one megacycle make the whole feedback problem almost child’s play. Indeed, it is only necessary to get power transistors which have a common-emitter cut-off frequency of, say 30 kilocycles and low-level transistors giving high-frequency performance to be able to break through to high fidelity.

Added to this we have an attitude of mind. The circuits which are now being used are complex and represent a level which I do not think we have had previously in the domestic field: indeed, they appear to be more complex than the submarine repeater which I saw in development just a week ago. To some extent this reflects limitations in the devices themselves and it also, I suspect, reflects a determination on the part of the designers to achieve the wanted performance in spite of the devices.

Transistors introduce quite a few new problems and some advantages. The low impedance of transistor circuits is a mixed blessing. As we shall see, it enables us to get rid of the output transformer. In return we find that we must use electrolytic capacitors: the last time I was told they were completely reliable nowadays I showed the salesman a Claim Form awaiting my signature from an engineer who was shot by one exploding. It is true that the catastrophic failures I have met have all been on high voltage types. A few years ago we even found electrolytics in the bass-boost networks, but they have mostly gone and the new

High Fidelity with Transistors

GEORGE FLETCHER COOPER

When the proofs, the figures, were ranged in columns before me; When I was shown the charts and diagrams to add, divide and measure them,

How soon unaccountable I became tired and sick.

Walt Whitman

Fig. 1. Generalized bridge circuit which is the basis for all OTL circuits.

Fig. 2. Current path during one-half cycle in Class-B system. Each transistor may be n-p-n or p-n-p.

Fig. 3. With truly balanced operation the centerline is a nodal axis and X can be located to give us two half bridges.

22

AUDIO • MAY, 1962
circuit should have more stable frequency characteristics.

Complementary symmetry is another advantage which the transistor designer has at his service. Combinations of n-p-n and p-n-p transistors have an extra degree of freedom which is especially useful in the later stages of an amplifier where impedances are getting lower and where we must make the transition from single-ended to push-pull. The resulting configurations have no tube equivalents.

Noise we might expect to be rather worse with transistor amplifiers: after all, one can get heater hum, unweighted, down below Johnson noise. It is easier to smooth high-voltage low-current supplies than low-voltage high-current, while transistors still make some noise of their own. The figures given for noise are thoroughly satisfactory, however.

Microphonic just does not come into the picture any more and I feel that we shall see this affecting future designs. Self-heating is, in some ways, a related feature. One manufacturer claims that his 40-watt stereo pair dissipates only 2 watts when quiescent compared with 150 watts for the equivalent tube system. At full load, of course, the input power and the dissipation rise, but the total power is only 60 watts and the power wasted is mainly wasted at the output transistors. Thus not only is there much less heat but the heat is generated at a small number of points and can be carried away by air flow without warming up the other components. The over-all result is that a complete stereo amplifier system takes up no more space than a single-channel tube preamplifier.

The present state of design indicates that the shaking-down process has hardly begun. New designs will move towards a common pattern: if I knew what that would be I should be in business. The first common feature we can see as probable in the future is the bridge output circuit. In Fig. 1 we see the arrangement in its theoretical form. There are several practical forms, which is why such a bare abstract form is shown as a beginning. It is safe to assume that there are no Class-A circuits in the mail to confuse the issue and we shall assume that we will always be dealing with Class B. I refuse to distinguish these subtle variations around the cut-off point. From some points of view the simplest form of Fig. 1 uses a transistor as each impedance. Considering one half cycle, Z1 and Z2 are cut off so that the circuit becomes just the speaker coil in series with two transistors as shown in Fig. 2. If the draftsman has not betrayed me you should not be able to identify the emitters: that is a deliberate omission, for various p-n-p, n-p-n combinations are possible although the circuits so far at hand show only p-n-p transistors right at the output. The other half-cycle, with Z1 and Z2 cut off, uses Z3 and Z4 in series. In this arrangement the peak voltages across the speech coil are equal to the supply voltage minus twice the transistor saturation voltage; the peak voltage across any transistor is the supply voltage.

The basic alternative is to make Z1 and Z2 short circuits at signal frequencies. If we redraw Fig. 1 as shown in Fig. 3, with the load (the speech coil) split in two, we can see that in the four-transistor bridge we have skew-symmetry about the center-line and therefore the point X should not move. Half the power is in RL1, and half is in RL2. Since X should not move we tie it firmly down. Now RL1 cannot know what happens to the right of the center line so we eliminate all the circuit there and we are left with Z1, Z2, RL1, and the joint for point X. Some designers use a capacitor, which can be returned to either side of the supply line: others split the supply and return X to the center point. If a single capacitor is used, there is some danger that the difference in quiescent currents in the two transistors may cause the steady value of the potential at X to drift away from the half-supply-voltage point. The peak swing across the speech coil (now RL1) is equal to the half-supply voltage: if this does not happen but is reduced by the amount of drift, Resistors, or complex feedback circuits, can be used to reduce this effect and the split-supply can be regarded as a particular low-impedance way of getting good centering.

The full benefit of the bridge of half-bridge OTL structures is obtained if there is no driver transformer. We find that it is here that complication really begins. One transistor in each arm of the bridge, or one transistor in the half-bridge, can be driven by a p-n-p unit acting as an emitter follower: some designers will obviously choose to form a Darlington pair. The other transistor is usually driven by a common emitter.

Fig. 4. Variation of basic circuit used in particular amplifier, Knight KN-450.

Fig. 5. The cascode circuit, grounded-emitter grounded-base amplifier gives low internal impedance.
n-p-n transistor with a small collector load and sometimes, though not always, with a substantial amount of local negative feedback from an undecoupled emitter resistance. It is in the provision of drive to these two stages that we see the most interesting variations.

The variation shown in Fig. 4 is relatively uncomplicated and used a driver transformer, as you can see from the circuit. The output stage looks pretty odd at first but each side of the half-bridge is, in fact, a cascode circuit, a common-emitter stage driving a common-base stage. This has low internal feedback and enables a high supply voltage to be used. The textbook drawing of the cascode is shown, with its simple skeleton, in (A) and (B) of Fig. 5. The driver transistor is, of course, a power transistor. In the circuit of Fig. 4 the feedback is very simple, just a resistor connected between the live end of the speaker and the emitter of the driver transistor but in a version of this circuit described by RCA the ground end of the speaker is taken through a small resistor in the driver emitter lead to provide current feedback as well.

A feature of the cascode circuit is that with the high voltage, some 80 volts centered on ground, it becomes worthwhile to provide a supply which is virtually a twin supply. The circuit of Fig. 4 runs one half-wave rectifier into the negative line, starting with -40 v. for the output stage and dropping through a succession of RC filters to feed the earlier stages with lower and quieter supplies, while a second half-wave rectifier, in the opposite sense, provides a positive 42-volt line for the other half of the output stage. If the output stage is fully driven there should be 40 volts peak across the speaker.

The circuit shown in Fig. 6 is also a half-bridge but, more conventionally, perhaps, in terms of current trends, uses a Darlington stage and a stage with a grounded-emitter n-p-n driver for the two active branches of the half-bridge. The supply here is a single-ended 28-volt so that a battery can be used. A large rectifier and a resistor added in the battery lead would let you keep the battery floating if you wanted to be sure of continuous working through a power failure.

The third of the American circuits is shown in Fig. 7. This is a full bridge and each of the power transistors has its own directly coupled driver. The four power transistors are connected in a basic symmetrical bridge configuration. This allows the maximum peak-to-peak voltage appearing across the load (speaker) to approach twice the d.c. power supply potential. In general, reliability and supply potential are inversely related. The use of four power transistors—rather than two—has the added advantage of lower power dissipation in each unit. The power transistors which constitute the four active arms of the bridge are driven in pairs. When transistor 1 is conducting, transistor 4 conducts and transistors 2 and 3 do not conduct. Similarly, when 2 and 3 conduct, 1 and 4 do not. Associated with each of the power transistors is a driver transistor. Power transistors 2 and 4 are driven by emitter-follower p-n-p units in phase opposition. Their input signal is derived from a conventional transistor phase-splitter circuit. Power transistors 1 and 3 are driven by n-p-n units connected as common-emitter amplifiers. The input signal to the n-p-n units is

(Continued on page 82)
Anecdotal History of Stereophonic Recording

RUSSELL J. TINKHAM

Reminiscences about the birth of stereo by one of the early participants.

In this fast-moving technological age, we often take new developments for granted. We’re amazed briefly, then accept the situation and hurry on with our own business. Only in our leisure moments do we find time to wonder how something has come about, and wonder about the motivations and trials of the people involved, and perhaps about what really went on behind the scenes.

It was inevitable, of course, since we have two ears, that someone would try to find a better way to use them for listening. After all, in the 1800’s we’d had binoculars and stereo pictures for the eyes...

In 1892, just sixteen short years after Alexander G. Bell’s historic “Mr. Watson, come here, I want you,” the first intelligible telephonic transmission, Bell demonstrated a binaural telephone. This was one of the scientific attractions at the World’s Columbian Exposition in Chicago. Two telephones were set up in one room, and the listener, in an adjoining room, clamped a receiver to each of his ears. He could tell the position from which a person in the first room was speaking.

Forty years later, in 1933, at the Century of Progress Exposition in Chicago, Bell Telephone Company showed “Oscar,” the tailor’s dummy, with two microphones set into the sides of his head. Oscar was in a small glass booth with a closed curtain between him and the thirty or forty people facing him. Each one held a pair of receivers clamped to his two ears. Each listener sensed that someone was moving around behind him, pouring water into a glass, or jangling a side the glass enclosure performing those many sound tricks one after another.

The year after Mr. Bell transmitted that first speech, Mr. Edison, on July 30, 1877, filed for a British patent on his tinfoil phonograph. Twenty-one or twenty years later (1898 or ’99) the Columbia Phonograph Company offered for sale, at $1000.00, the Multiplex Graphophone Grand (Fig. 1), the first known three-track (simultaneous) phonograph. This was a conventional cylinder phonograph except that it used “Three Separate Reproducers acting in absolute unison with three separate and distinct records (on the same cylinder)... The tones of the Multiplex are far more faithful to the original rendition of voice or instrument than those of any other talking machine. This fact is due to greater discrimination in the process of recording, rendered possible only by the use of separate recording horns and styluses.” But they didn’t call it “stereo”—or even “binaurial.” At $1000.00, this machine would now cost about $4000.00 based on the comparative purchasing power of the dollar. Can the body think hi-fi stereo prices are high today? Yet this machine was certainly the forerunner of quite an industry.

Of course, the objective of all developments along these lines has been to achieve naturalness and realism in the reproduction of music and sound. The ideal is the recreation of the concert hall in the living room (or placing the living room in the concert hall), a neat acous-

---

Fig. 1. Facsimile of ad for the first known three-track reproducer. (Reprinted from “From Tin Foil to Stereo,” copyright 1959 by Howard W. Sam & Co., Indianapolis, Ind.)

---

* Vega Electronics Corporation, Cupertino, Calif.
The music of Columbia Double Disc records is the music itself, not merely our idea of what we can make the people think music ought to be. You are assured of as perfect a record on each side of the disc as you ever bought before under any name at any price. Perfect in surface, perfect in tone, and extraordinary in durability, the Columbia process of recording produces a naturalness and roundness and perfection of tone that is positively unequalled in any other. And from the simple brassy notes of the bugle to the delicate tone shading of the violin, Columbia recording of instrumental music is marvelously true—And now the splendid ensemble of the full orchestra.

Despite such statements of finality from sales departments, engineers as a rule tend to ignore them. Engineers are naturally curious, and keep disproving such statements—and then propounding other statements just as final. For example, J. P. Maxfield and H. C. Harrison, of Western Electric, in an article published in 1925, dismissed the dual channel or binaural method as impractical. In its place, they advocated another technique, using two microphones to achieve an "artificial effect of placement." That same year, Mr. Maxfield was loaned by Western Electric to the Victor Talking Machine Co. where he organized and headed the Research and Engineering Department. This was the beginning of the scientific approach to recording, displacing the empirical methods which had been in use since Edison's time. Later, in 1929, Maxfield joined ERPI (Electrical Research Products, Inc., a subsidiary of W. E.) where he made important contributions to electrical recording of sound in perspective for motion pictures.

Since dual-channel recording was "impractical," the "Maxfield pick-up," using two microphones feeding a single channel, came into use for recording and broadcasting. For orchestral pickup, one omnidirectional mike was placed out in the auditorium at a point where the sound intensity of the direct sound was approximately equal to the intensity of the reverberant sound. The other, or accent, mike was placed close to the orchestra. This one preferably had a unidirectional response pattern and was used to pick up the weaker instrument sounds while minimizing the reverberant pick-up. Mathematical formulas were developed to calculate the correct positioning of the mikes in the room. This technique was used with great success on the Telephone Hour radio broadcasts during the 1940's.

By 1930, both the people at Bell Labs in this country and of Electric and Musical Industries, Ltd. (EMI) in England were deep in work leading to stereo sound reproduction. In the U.S., this work led to the sound of the Philadelphia Orchestra playing in the Academy of Music, Philadelphia, being transmitted over three separate telephone circuits and being reproduced in auditory perspective at Constitution Hall, Washington, D.C. This was in April, 1933. More will be said about this later.

And in England, on December 14, 1931, A. D. Blumlein, of EMI, filed for patent on the 45/45 disc cutter and reproducer. This patent (number 394325), twenty-two pages long, was issued June 14, 1933. The cutter could engrave either 45/45 or hill-and-dale/lateral grooves depending on how the associated circuitry was connected. Dr. G. F. Dutton, of EMI, has kindly furnished the pictures (Figs. 2, 3) of Blumlein's 1933 experimental "moving iron" cutter and the pickup used to play the resulting records. Dr. Dutton tells what happened next.

"The reproduction quality in these early days was limited by the surface noise of the shellac pressing, and by the tracking distortion due to the large reproducing stylus. The frequency range was limited both by the cutter and the reproducer heads, and it was very soon found that reproduction quality could not be sacrificed in noise, distortion, or frequency range in order to obtain a stereo system. In other words, a stereo reproduction can only be effective if each channel is operating under very-high-quality conditions. The stereo disc therefore was shelved pending the development and improvement of the gramophone technique."

The Bell Labs series of experiments, culminating in the Philadelphia-Washington transmission on April 27, 1933, has become classic. These experiments were reported in five articles published in the Bell Laboratories Record during 1933 and 1934. They were later reprinted by Audio in 1957 because of the great public interest in stereo which had by that time developed.

Dr. Leopold Stokowski, Director of the Philadelphia Orchestra, had been interested in the possibilities of electrical systems for the production of exceptional...
to-noise ratio of better than 80 db: silent passages were silent; no hum or hiss. It had an over-all acoustically equalized frequency response from 35 to 16000 cps: the instruments sounded natural, with a frequency distortion. And it had an acoustically equalized power handling capability of 20 watts: a bang on the tympani didn't fall apart upon reproduction. The illusion was said to have been astonishingly natural and lifelike. But this event was an instantaneous reproduction of sound. Recordings with such faithfulness, be they tape or disc, are still not commercially possible.

At the conclusion of World War II, German tape recorders found their way to this country via J. Herbert Orr of Western Electric, J. H. T. McClaughry of Irish Tape fame, Jack Mullen, now of Mincom, and the late Col. Richard Ranger. In 1945, Joe Begun, of the Brush Development Co., brought forth the first commercial tape machine in the U. S., the "Sound Mirror." In 1946, Marvin Camras at Armour Research Foundation, who already had several albums of potential in the magnetic recording field, labored in the chem lab for a month gradually accumulating a pound of iron oxide. He sent it to Minnesota Mining and Manufacturing Co. asking them to coat it on some 1/4-in. wide strips of tape. He felt this oxide coating would be an improvement over the few German samples and others that were then available. Camras said to be careful of that oxide coating would be an improvement over the few German samples and others that were then available. Camras said to be careful of that oxide coating didn't fall apart upon reproduction. The illusion was said to have been astonishingly natural and lifelike. But this event was an instantaneous reproduction of sound. Recordings with such faithfulness, be they tape or disc, are still not commercially possible.

At the conclusion of World War II, German tape recorders found their way to this country via J. Herbert Orr of Western Electric, J. H. T. McClaughry of Irish Tape fame, Jack Mullen, now of Mincom, and the late Col. Richard Ranger. In 1945, Joe Begun, of the Brush Development Co., brought forth the first commercial tape machine in the U. S., the "Sound Mirror." In 1946, Marvin Camras at Armour Research Foundation, who already had several albums of potential in the magnetic recording field, labored in the chem lab for a month gradually accumulating a pound of iron oxide. He sent it to Minnesota Mining and Manufacturing Co. asking them to coat it on some 1/4-in. wide strips of tape. He felt this oxide coating would be an improvement over the few German samples and others that were then available. Camras said to be careful of that oxide coating didn't fall apart upon reproduction. The illusion was said to have been astonishingly natural and lifelike. But this event was an instantaneous reproduction of sound. Recordings with such faithfulness, be they tape or disc, are still not commercially possible.

At the conclusion of World War II, German tape recorders found their way to this country via J. Herbert Orr of Western Electric, J. H. T. McClaughry of Irish Tape fame, Jack Mullen, now of Mincom, and the late Col. Richard Ranger. In 1945, Joe Begun, of the Brush Development Co., brought forth the first commercial tape machine in the U. S., the "Sound Mirror." In 1946, Marvin Camras at Armour Research Foundation, who already had several albums of potential in the magnetic recording field, labored in the chem lab for a month gradually accumulating a pound of iron oxide. He sent it to Minnesota Mining and Manufacturing Co. asking them to coat it on some 1/4-in. wide strips of tape. He felt this oxide coating would be an improvement over the few German samples and others that were then available. Camras said to be careful of that oxide coating didn't fall apart upon reproduction. The illusion was said to have been astonishingly natural and lifelike. But this event was an instantaneous reproduction of sound. Recordings with such faithfulness, be they tape or disc, are still not commercially possible.

At the conclusion of World War II, German tape recorders found their way to this country via J. Herbert Orr of Western Electric, J. H. T. McClaughry of Irish Tape fame, Jack Mullen, now of Mincom, and the late Col. Richard Ranger. In 1945, Joe Begun, of the Brush Development Co., brought forth the first commercial tape machine in the U. S., the "Sound Mirror." In 1946, Marvin Camras at Armour Research Foundation, who already had several albums of potential in the magnetic recording field, labored in the chem lab for a month gradually accumulating a pound of iron oxide. He sent it to Minnesota Mining and Manufacturing Co. asking them to coat it on some 1/4-in. wide strips of tape. He felt this oxide coating would be an improvement over the few German samples and others that were then available. Camras said to be careful of that oxide coating didn't fall apart upon reproduction. The illusion was said to have been astonishingly natural and lifelike. But this event was an instantaneous reproduction of sound. Recordings with such faithfulness, be they tape or disc, are still not commercially possible.
through the memory, the Philadelphia-Washington sound transmission came to a heated conference replete with more binaural recording. Could it be that we hear what we want to hear because our input to the brain from both ears at the same time—speaker in the store area, he was using headphones. The recording was a good (monaural) pickup. Then, in 10 or 15 seconds, he flipped a switch. A shiver ran up the writer's back, and the fuzz on his bald head felt as though it was curling. He'd flipped from one track feeding both phones to the two separate tracks feeding the separate phones. For all of his theoretical knowledge, he had never really had an opportunity to hear such a recording before.

Magnecord gave countless demonstrations of Carrington's recordings at many trade shows during the next year. Then Ched Smiley of Livingston Electronics, New Jersey, picked up the challenge and made the first two-track (staggered) commercially available binaural releases on tape. Some of the more affluent citizens of the land responded by purchasing both machines and tapes. But the going was rough, the musical groups weren't equivalent to orchestras led by Toscanini, and there weren't too many affluent music lovers.

Emory Cook, of Stanford, Connecticut, shortly thereafter marketed 12-inch diameter microgroove stereo discs recorded at 33 1/3 rpm. This was not the single-groove complex system used and as first done by Blumlein of England, but a two-channel system with one channel recorded on the outer half of the disc and the other concentrically recorded on the inner half. The two pickup heads were mounted several inches apart on a common arm and employed a micrometer screw adjustment between them. The handling of the pickup system was somewhat tricky, and this, with the short playing time of 12 minutes, left much to be desired, although the musical results were good.

The technique of using microphones spaced six inches apart employed by Magnecord at that time, and of reproducing the results over two widely spaced speakers led to some indifferent results during demonstrations. For example, take the two with the two miles spaced thusly in the center of a stage and the two loudspeakers used to reproduce the resultant recording spaced near the two sides of the stage. Whenever a person moved slowly from one side to the other in front of the two miles, upon playback he would seem instead to leap from one side of the stage to the other.

To gain experience, the author, by then, with Magnecord, took a Model 400 recorder with two-track, in-line heads to the University of Illinois, his alma mater. A week was spent recording both the University Symphony and the University of Illinois, his alma mater. A week was spent recording both the University Symphony and the University Symphony and Orchestra under Dr. Leopold Stokowski as guest conductor. Upon being introduced to the great man in the hotel lobby and learning that we were from Chicago, he asked, "Do you have your guns with you?"

As the concert was to be released monaurally over the nationwide NBC network at a later date, the university sound engineers as well as the writer's crew (himself) were busy prior to the first rehearsal stringing cables and setting up to make both monaural and stereo tapes. Magnecord had asked permission to record the concert, which the university gave them. Dr. Stokowski had graciously said he would stop at any point during the rehearsal that we wished to reproduce. He'd be making Victor records since before 1915. We were delighted with his offer of cooperation.

The monaural tapes for broadcast were to be made during the dress rehearsal, the stereo tapes during the actual performance. But when Stokowski conducts, he immerses himself in the music and forgets all else around him. The crew making the monaural recording missed a cue at one point; Stokowy got going before the recorder did and he kept going while the mixer engineer in the side balcony waved frantically for him to stop, per agreement. But the music went on. It was suggested that the mixer might attract Stokowski's attention by whistling. After all, it was a rehearsal and the recording was no good without a clean start. So with fingers in his ears and eyes closed the mixer engineer in the side balcony waved frantically for him to stop, per agreement. After all, it was a rehearsal and the recording was no good without a clean start. So with fingers in his ears and eyes closed the mixer engineer in the side balcony waved frantically for him to stop, per agreement. After all, it was a rehearsal and the recording was no good without a clean start. So with fingers in his ears and eyes closed the mixer engineer in the side balcony waved frantically for him to stop, per agreement.
basis for the three-track demonstrations at the West Coast Audio Fair in Los Angeles in February, 1953. Through the cooperation of F. H. Uecke, Director of Development Engineering for Capitol Records, a three-track demonstration tape was made up consisting of the Southern Pacific train coming into, stopping, and leaving the Glendale station; Lawrence Welk’s orchestra playing its theme song; the Santa Monica Symphony, and George Wright on the Wurlitzer pipe organ.

Ed Uecke has this to say about those days almost 10 years ago:

“In inquiring into our early history of stereophonic recording, I find that we really came in by the back door. Originally we experimented with a two-track recorder for ‘binaural’ reproduction using headphones and made several experimental recordings in 1952. I am enclosing two (2) photographs (Figs. 4 and 5) of a session done on April 25, 1952 showing an orchestra conducted by Harold Byrns. You will note the influence of the Naval Electronic Laboratories research using two (2) microphones spaced at the hatter’s block to simulate the head. The demonstration of localization using headphones was spectacular and we were all quite thrilled. Because of the way in which stereophonic reproduction had been handled in motion pictures, there was a strong inference that three-track recording would be necessary or at least highly desirable for loudspeaker reproduction. You may remember that there was a three-track 1/4-in. Ampex tape machine which made its appearance in Los Angeles and I believe that Santa Monica Symphony recording was done with this equipment. Anyway, it was not until August of 1953 that we obtained a satisfactory proposal from Ampex to construct a 3/8-in. three-track tape machine. This was delivered to us on January 6th of 1953 but was not immediately used for stereophonic recording. Its first application was to record vocal, choruses, and orchestras at the original session which was later to be mixed to obtain the best balance of sound for a monophonic record. One of our first sessions was with Gordon McRae done on January 10, 1953, and a few days later we made the now famous Lawrence Welk three-track stereophonic recording which was re-recorded to three-track 3/8-in. tape and used at the February, 1953, AES Convention. According to Bill Carn, who was the convention manager that year we had an attendance of 13,000 people at the demonstration February 5th, 6th, and 7th.”

Among those 13,000 people, one might expect, were several from various motion picture studios. Wide screen “CinemaScope” was about to be released in an effort to stimulate an industry beset by competition from home TV. Although much work had been done from time to time with multi-track optical film recording since the late twenties, eliminating with the Disney road show release of “Fantasia” in the late thirties, it took this demonstration of three-track magnetic tape to convince Hollywood that magnetic sound tracks on film, instead of optical, might be practical for general theater release. “Cinerama,” using seven magnetic channels on a separate film synchronously locked to the picture film, was then being shown in only two or three specially equipped houses in the country. It should be noted that Camras had shown magnetically striped film in 1947 to the SMPTE. So the first releases of “CinemaScope” were made with four magnetic stripes on the film, two on each side of the sprocket holes on each side of the film. Three stripes were wide and used for the three speaker channels behind the screen. The fourth was narrow and used for the “surround” speakers out in the auditorium to create special effects.

A few months after the 1953 Audio Fair demonstration, a phone call from Hollywood inquired as to whether Ampex was interested in providing some special recording equipment for a Mr. Anderson. Possibly. He would be up to visit the plant. Mr. Anderson and several others showed a few days later. When they were sure that the plant was interested, had the capability, and that no one could overhear the conference, Mr. “Anderson” was reintroduced as Michael Todd. Under the direction of Walter Solsted, formerly with Ampex as Director of Research, the company built a special 7-track system for him. This was the start of the Todd-AO system. Pentron, in late 1953, built a 6-track machine, their “electronic orchestra,” wherein six different orchestral instruments were recorded, one to a track. Six speakers were arranged physically in the room and the six musical instruments would normally be arranged. The jazz

---

Fig. 4. Byrns Orchestra binaural recording session, 1952, for Capitol records. Note the “blockhead” with two miles on the left. (Photo courtesy Ed Uecke, Capitol Records.)

Fig. 5. Closeup of the “ballots dummy” shown in Fig. 4.
reproduced was natural and stimulating at several hi-fi shows.

In 1954, John Leslie, formerly with Ampex as Chief Engineer for Professional Recorders, and the author, formerly Marketing Manager for the same company, decided to see what might be done to build an inexpensive two-track playback tape machine, one which might possibly fit the home pocketbook. A regular professional two-track stereo recorder carried a price tag of better than $2000.00. It was figured that many people who bought tape recorders used them at first only for playing the tapes they'd made and only occasionally thereafter used the recorder as a recorder. By this time, a compact extended-range speaker-amplifier had been placed in production and a small tape deck, the Model 600, was available. All that was needed was a two-track playback-only amplifier to feed two speakers, plus an inexpensive (1) two-track in-line head. We had to repackage the 600 and multiply it by two. The inexpensive two-track in-line head caused some problems. Although the project wasn't exactly authorized, management was forgiving when they heard the system as it played Hail to the Orange by the Illinois Band, and the Symphony Orchestra stereo tapes recorded in 1953. Arthur Fiedler had heard the center of orchestra in two groups of three each, middle right and left, for better stereo reproduction in hall. (Photo courtesy Sound Recording magazine. Adrian Siegal, photographer.)

In 1955, EMI first marketed stereophonic tapes in England for a home user. (Note the English spelling.) These were two-track, 7½ ips, as were RCA Victor's first releases. And for some time the English releases far exceeded those in the U.S. in number, but they were difficult to obtain on the west side of the Atlantic.

That same fall (1955), the writer made a tour of the major recording companies in this country showing them the two-track playback tape unit which Arthur Fiedler had heard. A demonstration tape had been assembled from a great number of tape dubs from old records, starting with the sounds of 1899 and progressing up through the years to the Jascha Heifetz sessions with the Hollywood Studio orchestra. You may recall the urgency of the situation, and the subsequent arrival of two of your engineers to attempt the alignment and re-checkout of the machines. Because of the mismatching of the heads, the re-recording of these masters had to be performed on the machines upon which they had been recorded.

“...As far as I can ascertain, the stereo disc idea in the United States was mine. This is difficult to pin down because many people have claimed they were working on the project during this period. However, the record speaks for itself; we did contact Westrex in 1954. To say that they wore less than the stereo tape, is understatement of the year. They finally agreed to consider the idea, although they cautioned me not to expect too much. Of course RCA management gave me little encouragement.

“About a year later, after a number of telephone calls, letters, etc., I decided to set up a meeting in Hollywood to deter-
Major demonstrations took place in 1956: one in Philadelphia on February 13, and one in San Francisco in early March.

Eugene Ormandy, conductor of the Philadelphia Orchestra, invited three companies (Ampex, Fisher Radio, and Jensen Manufacturing Co.) to participate with their equipment. On the-spot two-channel stereo recordings were to be made and reproduced immediately thereafter over speakers mounted on the stage to show how faithfully the full sound of the orchestra could be reproduced with modern recording and reproducing equipment. This concert was the best attended of any during the entire Philadelphia season. The program consisted of Britten's "Grownup's Guide to the Orchestra," Rimsky-Korsakov's "Caprice Espagnol," Bach's "Toccata and Fugue in D Minor"; and Strauss' "Dance of the Seven Veils."

About the "Caprice," said Rogers, who acted as commentator, "Here is a Spanish number with an Italian title written by a Russian and played by an American orchestra."

The Fugue portion of the Bach had previously been recorded during rehearsal. During the concert, the orchestra played the Toccata and were to fake the playing of the Fugue as it started, with the previously recorded section segued in at the start of it. Those of us responsible for riding gain and pushing the start button on the recorder had a few anxious moments, hoping nobody had dubbed the level, that the equipment would go when it was supposed to, and that the orchestra would be able to catch the cue. Ormandy, always a delight to work with, led into the Fugue and kept on conducting. The start button was pushed and the music came out. In about ten bars, the orchestra quit faking and laid down their instruments. The music kept playing. The audience responded generically, and the engineers relaxed to listen, too.

The following month, with the cooperation of Enrique Jorda and the San Francisco Symphony Orchestra, Walter Selsted headed a team that used a three-track machine, using 3/4-in. tape running at 30 ips, to put over the best piece of fakery ever. Three Altec 22D microphones were used. Three Altec theater speaker systems were buried—almost out of sight—in the midst of the orchestra. During rehearsals a sound-level meter was used in several parts of the hall to set the speaker acoustic level to match that of the orchestra. The acoustic frequency response of the system was carefully checked and appropriate equalizers were inserted to correct the over-all response to better than 12,000 cps. The usual tape hiss often noticeable on other systems was inaudible to all save those in the first few front rows, largely because of the optimum equalization possible at 30 ips.

The hall was virtually a sellout and the start button worked with, led into the Fugue and kept on playing. The segue from orchestra to tape was undetectable. It was so undetectable that a special announcement had to be made after the intermission because of the confusion. The orchestra hadn't really played at any time at all during the first number. It had all been faked. The comments overheard in the lobby after the concert indicated that even after the explanation some people still believed that the orchestra really had been playing part of the time.

Just before the intermission, several individual groups of musicians remained on stage. The trumpet player alternately tried to out-play the loudspeaker rendition of the successively more difficult variations on the opening theme and every other one of which he'd previously recorded for the purpose. The bassoon player played one part which was recorded, then played a duet with himself. Finally, the entire percussion section played several tricky bars. The tape came back with an even more tricky reproduction, previously recorded. Of course. Not to be outdone, the members really slammed the skins and beat the cymbals. The tape was set in motion, but no sound issued from the speakers. The tape was rewound and the live group tried to be recorded once again. The din was tremendous—actually far beyond the capability of the system's dynamics. The tape was again set in motion, but no sound came from the speakers. Suddenly, from each of the three speakers on the now virtually deserted stage, there issued a flash of fire and large billows of black smoke (old-fashioned photographic flash powder). The little old lady, a steady symphony patron, sitting next to the author's wife, said, "Oh, dear, that's a shame. All that expensive equipment! And I was so enjoying it all."

Later that summer, the author participated in a variety of listening tests in an effort to see what might be done toward housing both speakers of a stereo system in a single cabinet, together with radio, record changer, and tape recorder. We wanted one which might be acceptable from a size standpoint in anybody's living room. The original prototype then had two modified Model 620 speaker-amplifier assemblies hidden behind the grille cloth. Our listening tests finally led us to spaying the axes of the speakers 12 deg. from the centerline and ecked up from the horizontal about the same amount.

Recording two parallel tracks on tape was by now a simple accepted process. But tape machines compared to disc phonographs were expensive and awkward to thread and use. The public was

(Continued on page 91)
Webster defines a pioneer as “one who goes before, as into a wilderness, preparing the way for others to follow.” Here are some of the people who went before in audio.

Ben Bauer

I clearly remember how it all started: At the age of 4 or 5 some inexplicable demon compelled me to stick a bent wire into a power outlet. The resulting flash-bang was my first contact with electro-acoustic transduction! My formal entry into electroacoustics was much less traumatic but no less accidental. As a student at the University of Cincinnati during the depression, I heard of a co-op job in Chicago. The pay was to be 40¢ per hour but during those days we would have traveled to the ends of the earth for a job! The type of work? Developing microphones and pickups. No one knew too much about these products and the market for them was extremely limited. I asked Ralph Glover, at present Vice President of Jensen, but at the time Chief Engineer of Shure Brothers, how long he expected the market for microphones to last. “Five years,” was the reply, and this was good enough for me. Then Wilcox Gay came out with disc home recording in 1938 and we were off to the races with microphones, pickups, and magnetic record cutters which found their way into hundreds of thousands of homes in America. This taught me never to underestimate the capacity of the American public to accept complex technological advances where these served an important physical or emotional need. Being able to hear one’s own voice and saving for posterity the voices of dear ones definitely served such a need.

Without a doubt the late thirties were the formative years of high fidelity, and the field was fertile for improvements. We spent innumerable days pondering the formative years many of us became greatly concerned with the quality of disc recording and reproduction, and especially with the wear of stylus and records resulting from the 3–4 oz. stylus forces in then existing phonographs. We spent considerable effort in reducing these forces to below 1 oz. Then in 1938, a relatively unknown Harvard professor briefly caused a stir with his 2-gram pickup but he was too far ahead of his time to be labeled anything but a visionary. Since that time, Frede Jerrick V. (Ted) Hunt has been one of my favorite prophets and his theoretical work on groove-stylus relationships with Pierce, Lewis, and Miller has been the foundation of modern high fidelity. The academic people are often years ahead of the industry, which proves the value of untrammeled research. Just why such a large segment of industry refuses to heed this fact has always remained a mystery.

The war temporarily put an end to all the work and fun with disc recording and reproduction as we went about the grim business of manufacturing military microphones and headphones. But for me the drive to reduce stylus forces had become sort of a predilection. In 1947 I decided that it was time for another round of stylus force reduction and started a small project to develop a high-output pickup that would work at about ½ oz. Coincidentally, as this work was being finished Columbia announced the Long Play record! We only had to place a second point on the opposite end of the stylus shank and here was a turnover cartridge ready to be offered to the industry. The trend toward lower forces continued until 1957 when Shure introduced a 1-gram moving-magnet Studio Dynetic pickup. But the garden variety of home phonographs stayed with the 7–10 gram forces until this very day. Finally, a two-gram high fidelity stereophonic pickup-changer combination recently developed at CBS Laboratories is about to be commercially announced. It is interesting to reflect on how the record changer manufacturers traditionally resisted the lowering of stylus forces. They always come through, however, when commercial pressure is on.

Just as we have the 1–2 gram stylus force fairly well in hand, Ted Hunt again goes to an order of magnitude lower and speaks of 1/10 gram pickups, I guess we will have to find ways of lowering the needlepoint impedance of the dust which settles on records!

We all indulge in hobbies, and one of mine during the past years has been trying to convert the art of high fidelity into a science. During the thirties there was little in the way of measuring tools available. Any test records that could be obtained were wholly nondescript, and bore no relationship to what actually was to be found on commercial discs. Buchmann and Meyer developed a theory for test record calibrations by light patterns but there were alarming discrepancies between their theory and microscope measurements and the latter were impractical at high frequency. In the forties, I discovered that lack of parallelism of light rays was a cause for the errors and derived a correction formula. However, some inexplicable differences remained which were finally disposed of in the fifties by studying the effects of diffraction and interference of light. Subsequently, it came out that the problem has been tackled before but the previously proposed solution required the use of a special sextant-type instrument and subjective judgment while mine did not. This has reinforced my contention that a review of the literature is not always the best first step in solving a problem.
I am delighted to see that Anderson is continuing this work, having applied the diffraction pattern calibration method to strophonographic test records.

Another interesting interlude was work in connection with the measurements of dynamic characteristics and tracking forces, and it seems interesting we have had no harmonic analysis of this. I now try to appreciate the stylus compliance by wigglng the stylus between thumb and forefinger.

A gadgets engineer at the Allen-Bradley Company in 1938, a position which enabled me into contact with a large number of engineers, musicians and amateurs. If he was to make significant contributions to the reproduction of music, he needed much about the little nuances which distinguish great sound from the merely adequate.

G. A. Briggs

It is with great pleasure that I make my small contribution to the 15th Anniversary of Audio. The life of this journal just about agrees with the period of development of hi-fi, but I am not going to flatter the publishers by suggesting that they have been solely responsible for the phenomenal growth of interest in the subject.

The only other pre-war development worth mentioning here is the infinite baffle speaker designed by post office engineers in 1938. Fitted with a free edge cone, resonance 35 cps, this model still performs quite well but is not up to modern standards.
The publication of the first edition of Audio Engineering exactly 15 years ago might well be considered to mark the beginning of high fidelity as an industry. Until that time only a handful of audio pioneers were manufacturing quality sound equipment, and users learned about new developments largely by word of mouth. There was no means of mass communication directed toward families seeking to improve the quality of music in their homes.

Recognizing a rapidly growing interest on the part of the public in better sound, the far-sighted founders of Audio Engineering stepped into the communications gap with their May, 1947, issue—"the first magazine about high fidelity."

From that moment on, high fidelity manufacturers could direct news of their product progress to the readers most interested in high fidelity; at that moment, high fidelity stepped from the laboratory into the living room.

The first Bozak speaker system available to the music loving public was introduced in the pages of the infant Audio Engineering in May, 1949, and Bozak has continued ever since to use Audio to deliver news of its continuing program of loudspeaker improvement to the opinion leaders in the world of high fidelity.
In the pages of Audio, Bozak has informed knowledgeable audiophiles of such important “firsts” in loudspeaker design as:

—the first variable density cone and high compliance linear suspension to provide improved low frequency transient response.

—the first peak-free, direct radiating tweeters mounted in arrays for broad dispersion of highs.

—the first direct radiating speakers designed especially to reproduce the important mid-range frequencies.

—the first speaker systems with modular design to permit systematic growth and to prevent obsolescence of existing systems.

—the first (and much copied) single-cabinet stereo speakers using end doors as sound reflectors.

—the first fine furniture enclosures with matching cabinets to house electronic components.

—the first totally weatherproof high fidelity speakers.

—the first panel-mounted speaker systems for built-in installations.

The result has been mutually satisfying—for music listeners, for Audio and for Bozak. Audio continues to grow. Bozak continues its leadership in the loudspeaker industry. Music lovers continue to benefit from genuine improvements in the quality of music in the home.

Audio, for your part in the success of our industry, we at Bozak salute you.
industry which have always appealed to me. These are: (1) the customer is not always right; (2) it often pays not to advertise; (3) the small man often succeeds where the large company misses the hi-fi boat.

The fact that the customer is often wrong and the product not what it appeared to be even a few years ago, when one of them wrote to say that his speaker was satisfactory on the home service but distorted on foreign stations. We still enjoy ourselves pointing out to customers, in a polite way, when, where, and why they are wrong.

Advertising, if you are writing books or giving lecture demonstrations, the only way to succeed and to receive help from various quarters is to cut out the advertising of products.

Finally, the small man. There is no doubt that the hi-fi market needs personal attention, and I can cite six very large radio and electrical concerns in this country who have dabbled in hi-fi and then given it up as a bad job during the last recession, so, and I would say that the hi-fi journals have given excellent support to the little man (in the commercial sense) provided his ideas were sound (in the technical sense).

Anyway, it has suited me to work and play in a field where mass production methods and slogan selling systems can be booted out without stopping the game.

I suppose 1948 was my luckiest year because I then succeeded in borrowing enough money from the bank to enable me to pay my first visit to America, with a little book on Loudspeakers which I had somehow managed to get into print. I had the good fortune to run into Mr. Leonard Carduner, and thus began a valuable association between Idle, Bradford, Yorkshire, and the newly developing hi-fi interests of the U.S.A. The lucky part was, of course, the timing; ten years sooner or later would have been comparatively useless.

Then in 1955 and 1956 we gave a couple of lecture/demonstrations in Carnegie Hall, which were rather bold ventures with many pitfalls, but the incident which stands out most clearly in my mind occurred on the day of the first concert when I called at the barber's shop near the Barbizon Plaza Hotel and asked to be smarten up for the occasion. They gave me a blue rinse!

I have been surprised that more live recorded concerts have not been given in America. For about twenty of such efforts I have retired from the fray, but I believe greater realism could be achieved today with two channels working.

VICTOR BROCINER

Victor Brociner is a native New Yorker and a graduate of Columbia University (1931). He is a member of the Audio Engineering Society, the Institute of Radio Engineers, the Acoustical Society of America, and the Radio Club of America. Although his formal training involved specialization in internal combustion engines, he gravitated into electronics soon after receiving his degree. For a number of years he was concerned with industrial applications of photocells for control and measurement. In 1937 he and two associates formed the Philharmonic Radio Company which pioneered in the high fidelity field, manufacturing a wide-band hi-fi radio-phonograph.

World War II shifted these activities to the field of military electronics. Subsequently, Mr. Brociner formed his own company, marketing a line of high fidelity amplifiers and loudspeakers under his own name until 1957, when he became consultant to a number of firms in hi-fi and industrial electronics. He joined Uni- versity Loudspeakers, Inc. in March 1958 as full-time Staff Consultant. He became Director of Engineering in the Fall of 1960.

The Philharmonic wide-band radio-phonograph mentioned above was probably the first truly hi-fi instrument commercially produced in this country. It was designed under Brociner's direction, with William Weeden as consultant. The 30 cps to 10,000 cps from antenna to voice coil, on AM (of course) delivered 25 watts of power, with negative feedback back over 3 stages. Even at this early date, the speaker system comprised a woofer-tweeter combination, in a closed compartment. A sample of this Philharmonic receiver is now in the Smithsonian Institute, donated by Avery Fisher. After World War II, Brociner pioneered in the design and commercial production of a phonograph preamplifier for the recently introduced magnetic cartridges, offering a wide range of adjustable equalization characteristics. At that time, no standard frequency characteristic had been adopted for recording, and records of different manufacturers sounded quite different when played with fixed playback equalization. The feature of adjustable phono equalization eventually became standard on all hi-fi amplifiers. Since the adoption of RIAA equalization, this feature is gradually disappearing from general use, although it is still retained on the more elaborate amplifiers and retains its utility for those having extensive record collections not all of which were recently acquired.

When the ultra-linear power amplifier circuit was introduced, Brociner immediately recognized its advantages and was the first on the market with an ultra-linear power amplifier, producing it first for Audio Exchange and then as the Brociner Model UL-1. As the hi-fi market developed it became evident that the bulk and cost of equipment was such that many compromise with quality of performance or reliability. The Brociner Mark 12 Integra Amplifier answers these demands by using etched circuit boards ("printed circuits") in a combined preamplifier-amplifier in a compact package.

In speakers, Brociner was the first to produce commercially a corner horn speaker system licensed under Klinghofer patents. Later, he introduced the Model 4 Corner Horn, powered by the remarkable British Lowther PM2 speaker, which evolved from the early pioneering efforts of P. G. A. H. Voigt. In addition, he marketed a very early version of today's fast-loaded cabinets under the name DUCTFLEX.

Leonard Carduner

Leonard Carduner joined British Industries shortly after its founding (by his brother, William Carduner, in 1937). The company was formed to introduce Garrard record-play ing equipment to the U. S. market, and has continued to be the sole American marketing organization.

Before World War II, Garrard was sold largely for use in fine packaged sets. There was little or no consumer market for components, per se. Immediately after the development of the LP record, the Garrard RC-80 was announced and, under Leonard Carduner's direction, the company began its efforts to introduce the concept of a true high fidelity record changer to the hobbyist and to pioneer in the development of a consumer high fidelity market. At the time, there were few distributors taking a serious interest in the possibilities of developing a consumer demand for component music systems. They were reluctant to act as retailers (despite the growing demand), because they feared this might jeopardize their standing as "jobbers." In conjunction with a very small number of manufacturers, Leonard Carduner devoted a great deal of time to personal visits and contacts with distributors, in order to convince them of the existence of the market, and to persuade them to adopt the up-to-date merchandising techniques used by retailers of fine equipment in other industries. His efforts gradually succeeded, and this was reflected by the acceptance of the Garrard line and the growth of British Industries Corporation.

From this difficult beginning, BIC grew steadily in electronics and other fields, introducing to the American market a variety of excellent British products. These have included Multicore Solder, Gold Lion Tubes (formerly called Genalex Tubes) made by the General Electric Co. of England, Leeds Amplifiers, unsurpassed Wharfedale Loudspeakers and books by G. A. Briggs.

Mr. Carduner's contributions to certain milestones in the development of high fidelity have included:
A. A personal campaign of travel and

www.americanradiohistory.com
3 MICROPHONES FOR ALL STEREO

ALL OF THESE INTENSITY STEREO PATTERNS

<table>
<thead>
<tr>
<th>M-S</th>
<th>X-Y</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="M-S Pattern" /></td>
<td><img src="image2.png" alt="X-Y Pattern" /></td>
</tr>
</tbody>
</table>

PLUS

TWO SEPARATE CONDENSER MICROPHONES FOR A-B STEREO OR MONO USE

TWO SCHOEPS CM 66 THREE PATTERN CONDENSER MICROPHONES

with patented Multiple-Pattern, Single Metal Diaphragm construction.

The EST 60 STEREO ADAPTER COMBINES THESE TWO PROFESSIONAL MICROPHONES INTO A M-S or X-Y STEREO SYSTEM.

The PERFECT ANSWER FOR ALL STEREO & MONOPHONIC RECORDING and FM MULTIPLEX STEREO BROADCASTING.

OUTSTANDING FEATURES OF SCHOEPS CM 66

DISTORTION: Less than 0.3% to 115 dB
FRONT TO BACK RATIO: Greater than 26 dB
ATTENUATOR: Switchable 15 dB Before Preamplifier
OUTPUT IMPEDANCE: To match standard 30/50 or 150/250 Ohms

INTERNATIONAL ELECTROACoustics INCORPORATED
333 SIXTH AVENUE
NEW YORK 14, N. Y.
212 WA 9-8364

AUDIO • MAY, 1962
education to parts distributors, to persuade them to enter the field of retail merchandising for high fidelity components.

E. Establishment of the Garrard RC-89 record changer in 1949, a product which literally made history in the field.

In 1950, he established the doctrine of the at least as extensive as those behind the finest domestic products.

D. In 1955 and 1956, Leonard Carduner sponsored and presented the first concert-demonstration before an audience, those behind the finest domestic products.

C. In 1950, he established the doctrine of the audio industry—a marketing policy based on the concept that no product should be marketed in a market that it has some special characteristics to offer the American consumer not obtainable in domestic products... and supported by parts and service facilities that are as extensive as those behind the finest domestic products.

B. Establishment of the Garrard record changer in 1949, a product which never before had been associated with, it seems quite suddenly that I have done singularly little.

A. Howard J. Johnston, who I often heard people say they were not familiar with, only because I had创造了 the concept that no product should be marketed in a market that it has some special characteristics to offer the American consumer not obtainable in domestic products... and supported by parts and service facilities that are as extensive as those behind the finest domestic products.

In 1950, he established the doctrine of the audio industry—a marketing policy based on the concept that no product should be marketed in a market that it has some special characteristics to offer the American consumer not obtainable in domestic products... and supported by parts and service facilities that are as extensive as those behind the finest domestic products.

D. In 1955 and 1956, Leonard Carduner sponsored and presented the first concert-demonstration before an audience, those behind the finest domestic products.

C. In 1950, he established the doctrine of the audio industry—a marketing policy based on the concept that no product should be marketed in a market that it has some special characteristics to offer the American consumer not obtainable in domestic products... and supported by parts and service facilities that are as extensive as those behind the finest domestic products.

B. Establishment of the Garrard record changer in 1949, a product which never before had been associated with, it seems quite suddenly that I have done singularly little.

I developed a compact filter with variable-frequency response — cut-off—that was never exploited. I developed a universal crossover-cam output transformer, capable of feeding any combinations of woofers and tweeters and matching any output tubes, with any crossover frequency—that was never exploited.

I developed a new type stereo loudspeaker that only needs one small piece of furniture in the room and isn't so critical of placement as the more conventional system—that was never exploited. I tried to learn and tried and tried to get someone to adopt a sensible approach toward the high fidelity sound system with the room acoustics, so that expensive, high-quality equipment isn't just wasted by improper use—a sensible, I think, approach to optimization. Sometimes I have been thrown in a new circuit for extra measure (usually because the Editor said it wasn't good enough and had to be better the next time, which we were our best critics —it was never good enough and had to be better next time. That's a good combination for an engineer.

After World War 2, when the rehabilitation to peace time high fidelity was paralyzed by the government red tape, I decided my fortunes would fare better elsewhere and moved out, along with some other pieces of furniture.

Since then my writing activity has sought to place the benefit of my experience at the disposal of others. First my design methods were committed to print, then I expounded on the relative merits of different approaches to design and optimization, and then I published otherwise. A year or so following its publication of the present book, the Government ordered further schematics from manufacturers would reveal that several of them were using those suggested new features exactly as he had committed them to print. When the government red tape, I decided my fortunes would fare better elsewhere and moved out, along with some other pieces of furniture.

Since then my writing activity has sought to place the benefit of my experience at the disposal of others. First my design methods were committed to print, then I expounded on the relative merits of different approaches to design and optimization, and then I published otherwise. A year or so following its publication of the present book, the Government ordered further schematics from manufacturers would reveal that several of them were using those suggested new features exactly as he had committed them to print. When the government red tape, I decided my fortunes would fare better elsewhere and moved out, along with some other pieces of furniture.
"The ONLY Professional Tape Recorder for Me,"
says GIL STRATTON, well known TV Sportscaster.
"You’ll see what I mean when you try the
FULLY PROFESSIONAL ROBERTS 192."

ONLY THE ‘192’
ROBERTS PROFESSIONAL Monophonic Tape Recorder
gives you... Fulltrack or Halftrack • Hi/Lo Impedance input switching • 8/600 Ohm Balanced Output • Self Contained Speaker • Frequency Response: 40 to 15,000 cps at 7½ ips, ± 2db; 40 to 5500 cps at 3½ ips, ± 3db. • Signal to Noise Ratio: 50 db below recorded "0" level. • Tape Speeds: 7½" or 3½" per second. • Wow and Flutter: Less than 0.18% RMS. • Heads: Inline record/playback head in shielded housing; full track or ½ track available. • Motor and Drive: Precision balanced hysteresis synchronous motor, to speed stabilized flywheel/capstan tape drive. • Amplifier: Professional terminal board wiring used; cast front panel; 6 watts undistorted output. • Equalization: Amplifier record and playback equalization based on broadcast (NAB) standards. • Inputs and Outputs: Jacks provided for low level, high impedance microphone input; high level input; auxiliary speaker or line output; input/output jacks for connecting directly to either or both channels. • Index Counter: Accurate, three digit type. • V.U. Meter: Illuminated, calibrated –10 to +3db. • Operating Position: Vertical or horizontal. • Reel Size: 7” maximum (up to 2400” of tape). • Dimensions and Weight: 15½” x 14½” x 9½” overall 28 lbs. • Interlocking Controls: Prevent accidental erasure of recorded tapes; instantaneous start and split second acceleration. • Pause Lever: Permits instant stops during recording, simplifies editing and facilitates setting volume level before recording. • Power Requirements: 95 to 120 volts, 60 cycles, 50 W.

10½” Reel Adaptor Now Available—$49.50

ROBERTS ELECTRONICS, INC., Dept. A-5-C
5920 Bowcroft Ave., Los Angeles 16, Calif.
Please send me:
☐ Roberts Stereo Tape Instruction Manual containing stereo and monaural applications.
I enclose 25¢ (cash, stamps) for postage and handling.
☐ The name of my nearest dealer.

Name ____________________________
Address ____________________________
City ____________________________ State ____________________________

ROBERTS ELECTRONICS, INC.
5920 Bowcroft Avenue, Los Angeles 16, California
MFRS. OF ROBERTS SONIC-THESIS, MEDICAL EQUIPMENT, STEREO HEAD PHONES, NEGATIVE ION GENERATORS, AUDIO EQUIPMENT AND MAGNETIC RECORDING TAPE

AUDIO • MAY, 1962
some of his writings in the formation of a comprehensive audio technology"... As well as a few magazine articles, I've written a few books about it. In case you have difficulty counting up to 300 articles, some of them appeared under other names—like Ravenswood. Maybe it was ironic that, when a certain company was sued for using a certain respected name, they should pick the name Ravenswood to change to! But, although I used it before they did, I see no reason to sue. I couldn't afford to, anyway!

Arthur C. Davis

Some of Arthur Davis's developments in the audio field were: The vertical mixer control; pan pots in conjunction with J. N. A. Hawkins of Disney Studios; brought out first passive program equalizers; developed and built the first magnetic sprocket driven sound-on-film recording machine (holds patent on this); has recently developed complete passive graphic equalizers; holds patent on polarized relay; on straight line attenuator, and coaxial TV type attenuator.

Sherman Fairchild

Sherman Fairchild first became commercially interested in audio when his company, Fairchild Camera & Instrument Corporation, in the early thirties accepted a contract to manufacture a disc recorder using aluminum discs. The owner and developer of this recorder was unable to move the inventory which the Fairchild Camera Company had built because the quality of the machine was so bad. In order to move this inventory, Fairchild put two of his engineers (now in the Bell Telephone engineering department) to work to redo the product. These engineers did such an outstanding job that the resulting recorder was accepted as the best of its kind, and this launched the Fairchild name in the audio business. Very soon aluminum records went out and acetate records came in.

Shortly after this time, Fairchild engineers thought about audio products and about this time Ted Lindenberg came from Cleveland and joined the Fairchild organization. The thought was that Fairchild Camera would have a broad line of audio products after the war. Unfortunately for these audio developments, very large commercial subcontracts came into Fairchild Camera after the war and the introduction of their audio equipment was delayed until a large part of the post-war demand had been satisfied by other producers. Fairchild did have outstanding gear-driven playback turntables, recording lathes, cutters, pickups (moving coil) and arms (which some people will remember as the old "Cobra" arm).

At this time, it was also evident that tape was going to be coming into the market and Fairchild had no tape recorder and no engineers who were up to date on tape. To say the least, the outlook for the audio products part of Fairchild Camera looked rather dim and the directors and management of the company decided that it would be more profitable for the company to concentrate its efforts in other fields.

Sherman Fairchild, however, was tremendously interested in the audio business and did not want to drop it. At the same time, he had to think first of the interests of the stockholders in Fairchild Camera & Instrument. The way out of this dilemma which prevented the Fairchild audio equipment from being dumped on the market, was for Fairchild to form Fairchild Recording Equipment Corporation, put up the money for this organization himself and take over the inventory from the Camera Company and liquidate it in an orderly fashion for the Camera Company stockholders.

About this time, he made an arrangement to acquire the tape recorder engineered by Dr. D. G. C. Hare. One of the prime movers in Fairchild Recording Equipment Corporation was Mr. Wentworth Pling, now Vice-President and Chief Engineer of Cinemama. Through Mr. Pling, and with the help of Dr. Hare, the Fairchild professional tape recorder was developed. This machine was full of innovations which gave not only better motion but better sound quality than other machines then available. Unfortunately because all of the audio components were plug-in and completely interchangeable, the entire equipment was expensive and competitive equipment was offered at little over half the Fairchild price. Fairchild, however, did pioneer the synchronization of tape with sound in its pic-sync machine and even went to the point of developing equipment for CBS where the sync tape started up in sync with the motion picture film and maintained its sync for a period of an hour.

Fairchild designed and built equipment which printed frame lines and footage marks on tape so that it could be easily cut with motion picture film, but most motion picture film editors preferred to use the visible sound track with which they were well-acquainted. Although hundreds of tape recorders eventually were sold, Fairchild did not push its expensive machine. It is interesting today to note that these machines sell second-hand for as much as they originally cost new. Many people still consider them the finest professional equipment in the world at any price.

Fairchild Recording Equipment Corporation did push its line of hi-fi equipment, both professional and for the audio fan. This company pioneered the first stereo pickup. It was the originator of the modern belt-drive turntable and today molds and manufactures its own belts. It brought out and installed in many studios, one of the two American stereo record cutters. Recently it pioneered the incorporation of cadmium sulphide cells in audio control circuits.

Fairchild's commercial audio history has not produced the largest volume of sales, but few companies have produced as many innovations or have pioneered as many new audio devices.

Avery Fisher

This year Avery Fisher is celebrating his twenty-fifth anniversary as a maker of high-fidelity equipment. As the dean of the industry, he looks back with pleasure on the tremendous growth of public interest in the audio hobby, mixed with not inconsiderable astonishment at its magnitude. For when he first opened the doors of his establishment in 1937, in a small loft on West 21st Street, New York, patrons were few and far between. The true practitioners of the hi-fi hobby were limited in number, as were the available sources of good programs—whither from records or radio. Today Avery Fisher heads the largest high fidelity manufacturing facilities in the industry, with plants in New York, Pennsylvania, and New Jersey. The largest unit is also the newest; it is the 62,000 square foot Fisher plant on a twenty-acre site—Fisher Park, Milroy, Pennsylvania.

In spite of the magnitude of the company's operations, Avery Fisher has continued to maintain direct contact with hi-fi enthusiasts seeking information or...
The most revolutionary development in the JBL Linear-Efficiency series is the new LE14C, a divided network system with low frequency unit and high frequency unit mounted concentrically. Its total, accurate coverage of all useful frequencies sets a new standard for space-saving, long-linear-excursion loudspeakers. Although the bass cone is fourteen inches in diameter, the unique stepped frame design permits mounting the LE14C in enclosures which heretofore would accept nothing larger than a twelve-inch unit. The LE14C has a four-inch voice coil. This allows a new high frequency unit to share the same axis. With a precision dividing network specifically engineered for this system, the uniform acoustic coupling and precise phase relationship established between the two cones results in an imperceptible transition of energy radiation through the 1,000 cycle crossover region. Write for your free copy of Bulletin SB1203 describing the LE14C in detail.

NEW HIGH FREQUENCY LOUDSPEAKER
Remarkably versatile, highly efficient, the JBL LE20 spans the sonic spectrum from 1200 cps to beyond the limits of aural perception. With its companion network JBL Model LX2, the LE20 can be used with either low frequency drivers or full-range speakers of either high, medium, or low efficiency. Preview listeners have been consistently impressed with the LE20's pleasant, clean, sensationally linear response. JBL Bulletin SB1204 describes the LE20 and LX2 in detail.

NEW DIVIDING NETWORK THE LX2
Designed to adapt the LE20 to any of its many possible assignments, the LX2 features variable crossover. A three-position switch permits selection of 6000, 3000, or 1500 cps as the roll-off frequency for the LE20. Reactance of the network/transducer combination is such that they will operate perfectly with bass drivers having a nominal impedance of from 8 to 16 ohms. An attenuator permits balancing the level of the two transducers in the system.

NEW JBL OPUS, MODEL C52
Descended from the magnificent JBL Olympus and the versatile JBL Apollo, the new Opus is a compact, beautifully designed and finished Linear-Efficiency system for shelf or table-top. It may be ordered with either the S9 or S10 two-way divided network system installed. The former includes the LE75 high frequency unit, the latter the LE85. Both utilize the LE10B ten-inch L-E bass transducer. The exposed acoustical lens distributes sound smoothly through a 120° horizontal x 45° vertical pattern. Lens may be rotated 90° if vertical placement of the enclosure is desired. The Opus also accepts the new LE14C, in which case the lens is replaced by a wood panel. It measures just 28" x 14" x 14½" deep.

The most revolutionary development in the JBL Linear-Efficiency series is the new LE14C, a divided network system with low frequency unit and high frequency unit mounted concentrically. Its total, accurate coverage of all useful frequencies sets a new standard for space-saving, long-linear-excursion loudspeakers. Although the bass cone is fourteen inches in diameter, the unique stepped frame design permits mounting the LE14C in enclosures which heretofore would accept nothing larger than a twelve-inch unit. The LE14C has a four-inch voice coil. This allows a new high frequency unit to share the same axis. With a precision dividing network specifically engineered for this system, the uniform acoustic coupling and precise phase relationship established between the two cones results in an imperceptible transition of energy radiation through the 1,000 cycle crossover region. Write for your free copy of Bulletin SB1203 describing the LE14C in detail.

Hear these newest contributions to the art of total audio recreation at your first opportunity. Visit the Authorized JBL Audio Specialist in your community. JBL Precision Transducers are manufactured by James B. Lansing Sound Inc., and are marketed by JBL International, Los Angeles 39, California.

AUDIO • MAY, 1962
having special problems. He is always available personally to those who write, telephone, or visit him at the Long Island City headquarters.

How did it all start? Most logically. Avery Fisher was born into a highly musical family, one in which each youngster was taught to play a musical instrument at an early age. Avery was constantly exposed to music from Father’s record collection. Charles Fisher, père, began his hobby at the time disc were replacing cylinders and turntable power came from a crank handle and spring with a maximum capacity of five minutes playing time.

Avery Fisher’s mastery of the violin led, in later years, to the greatest of all participation experiences available to a musician—string quartet and chamber music sessions in his home. Begun thirty years ago, his collection of chamber music, reference library on musical subjects, and collection of recordings is perhaps without an equal.

He has had the privilege of building high-fidelity equipment for the world’s great concert artists, opera stars, for royalty and heads of state as well as world leaders; fields of science, education, industry, publishing, broadcasting, and the theatre from the royal palaces of Bangkok and Tehran to the new (no one in apartment centers).

Avery Fisher’s first model (1937) featured a broad-ranging TRF tuner with a 20-kc bandwidth and a twenty-five watt inverse-feedback amplifier, built on two chasiss. In a ceremony at the Smithsonian Institution, Washington, D. C., early in 1960, this historic unit was accepted for the permanent collection of the Institution as the first commercially practical recording instrument.

With the exception of the war years, when his company was engaged in the production of electronic equipment for the military, each year has seen new and basic developments from the Fisher laboratories.

Avery Fisher’s long-standing reputation in industrial and typographic design is reflected in the appearance features of all Fisher products, whose styling he personally supervises. His reputation in the field of typographic design is such that when arrangements were completed for the book “Churchill’s History of the English Speaking Peoples,” the American publishers asked him to design these books, and when the book was published, Avery Fisher was frequently asked, by those who encounter his name in these volumes, whether he has a relative or namesake who designs books.

Avery Fisher has been elected a member of The Players, as a patron of the arts. The club was founded in 1888 by Edwin Booth for leaders in the theatre, publishing, and the arts.

Guy R. Fountain

The initials “G.R.F.” symbolize in Great Britain the initials not only of a wide range of loudspeakers, but the initials of Guy R. Fountain—one of the earliest founders in England of high-quality, high-power audio apparatus.

Due to the absence of high-voltage dry batteries in the early twenties, he patented and manufactured an ingenious rectifier eliminators. Transformers, and an electrolytic rectifier which employed as the positive rectifying electrode an alloy of tantalum. He abbreviated “Tantalum Alloy” to TANNOY, and thus was born a registered Trade Mark, which during the war years appeared some eighteen million times on the European battlegrounds.

How did it all start? Most logically. Avery Fisher was born into a highly musical family, one in which each youngster was taught to play a musical instrument at an early age. Avery was constantly exposed to music from Father’s record collection. Charles Fisher, père, began his hobby at the time disc were replacing cylinders and turntable power came from a crank handle and spring with a maximum capacity of five minutes playing time.

Avery Fisher’s mastery of the violin led, in later years, to the greatest of all participation experiences available to a musician—string quartet and chamber music sessions in his home. Begun thirty years ago, his collection of chamber music, reference library on musical subjects, and collection of recordings is perhaps without an equal.

He has had the privilege of building high-fidelity equipment for the world’s great concert artists, opera stars, for royalty and heads of state as well as world leaders; fields of science, education, industry, publishing, broadcasting, and the theatre from the royal palaces of Bangkok and Tehran to the new (no one in apartment centers).

Avery Fisher’s first model (1937) featured a broad-ranging TRF tuner with a 20-kc bandwidth and a twenty-five watt inverse-feedback amplifier, built on two chasiss. In a ceremony at the Smithsonian Institution, Washington, D. C., early in 1960, this historic unit was accepted for the permanent collection of the Institution as the first commercially practical recording instrument.

With the exception of the war years, when his company was engaged in the production of electronic equipment for the military, each year has seen new and basic developments from the Fisher laboratories.

Avery Fisher’s long-standing reputation in industrial and typographic design is reflected in the appearance features of all Fisher products, whose styling he personally supervises. His reputation in the field of typographic design is such that when arrangements were completed for the book “Churchill’s History of the English Speaking Peoples,” the American publishers asked him to design these books, and when the book was published, Avery Fisher was frequently asked, by those who encounter his name in these volumes, whether he has a relative or namesake who designs books.

Avery Fisher has been elected a member of The Players, as a patron of the arts. The club was founded in 1888 by Edwin Booth for leaders in the theatre, publishing, and the arts.

Guy R. Fountain

The initials “G.R.F.” symbolize in Great Britain the initials not only of a wide range of loudspeakers, but the initials of Guy R. Fountain—one of the earliest founders in England of high-quality, high-power audio apparatus.

Due to the absence of high-voltage dry batteries in the early twenties, he patented and manufactured an ingenious rectifier eliminators. Transformers, and an electrolytic rectifier which employed as the positive rectifying electrode an alloy of tantalum. He abbreviated “Tantalum Alloy” to TANNOY, and thus was born a registered Trade Mark, which during the war years appeared some eighteen million times on the European battlegrounds.

The use of the Tannoy high-voltage rectifiers enabled high-quality power amplifiers to be pioneered using power triodes, which were the only valves available in those early days.

Mr. Fountain’s organization grew steadily, and in the late twenties and early thirties, he was producing not only high-quality audio amplifiers, but amplifiers having undistorted outputs of 100 watts and more. In 1934, having equipped both super-quality radio the British L.M.S. President’s railway coach, he was commissioned to equip the Royal train, an installation which became the prototype for many high fidelity outfits. Even in those days, twin loudspeakers were employed. In 1934/1937, Tannoy high fidelity equipment was available, which represented the high standard available in that era.

In the Radio Exhibition of 1935, a high-quality stretched-diaphragm capacitor microphone was exhibited with a three-stage head amplifier contained in the tubular stand. This exhibition also displayed loudspeaker characteristic recording equipment which Tannoy pioneered and which was not only for their own use, but for other manufacturers’ laboratories.

At the beginning of the Second World War, Tannoy resources, which by this time had grown very considerably, were employed to produce a range of audio communication equipments for tanks, gun batteries, airfields, submarines, and so on, to such an extent that, by the end of the war, Tannoy had become almost a generic term for loudspeaker equipments, and even today in Great Britain people use the word Tannoy as a verb, indicating the act of broadcasting to large assemblies.

Peace saw further ramifications in the now broad field of Tannoy audio activities. Much effort and development lead to the design of the internationally known “Dual Concentric” loudspeaker; designed primarily as an audio measuring device between an electronic amplifier and the ear, it soon became a desirable commodity with the introduction of long-playing records, FM radio, and high-grade high fidelity in homes throughout the World.

Mr. Fountain’s organization, however, was reaching out still further afield, specializing in speech reinforcement and simultaneous interpretation facilities. Tannoy equipment became permanent features not only in the House of Commons, Parliament House of London, but also in the Parliament and Government buildings throughout the World, such as the United Nations, Commons, Senate, House of Lords, Parliaments, Nations, Manhattan; Geneva; Paris; and so forth.

The tradition and standards of Tannoy are still being carried forward by Mr. Fountain and his elder son, Michael, who with his family still remain the sole proprietors of the Tannoy Company, which is operated by executives, few of whom have been with the company for less than 25 years.

Sidney Frey

Forty-year-old Audio Fidelity President Sidney Frey started in the recording business in 1948. Not by choice, however. A business venture that didn’t pan out left him holding the bag—a "bargain" of equipment he’d sold to thousands of them. But the dynamic Mr. Frey managed to find retail outlets for these records, and sales took off, in the manner you can say "stereophonic sound" he was a record distributor. He obtained distribution rights to other unusual musical instruments (no one in apartment centers) and was soon noted as a source for this kind of material.

At the start, the distributing company, Dauntless International, was a two-person operation—the other party was Frey’s wife, Robbie. Today, the Freys live very comfortably in Riverdale and have two daughters, 6 and 8. Today, too, the Frey business family named Audio Fidelity—"Mr. Frey” has a hundred people and is a record-producing establishment—in both senses of the word.

A native New Yorker, Frey studied engineering at CCNY. World War II interrupted his studies and he shipped out as radio's ship's carpenter in the Merchant Marine; and following the war, he became an exporter—of machinery, or anything that "looked good." The word "stereophonic" appeared in the dictionary as early as 1949. Frey, who was engaged in at the time he was precipitated into the record business, said, "I recognized 'stereophonic sound' as an avid record collector, with a penchant for south-of-the-border rhythm (as indeed evidenced by one portion of the Audio Fidelity line).

Soon after becoming a distributor, Frey—being Frey—began to dabble in producing his own records. You would call most of them records he recorded and/or distributed off-beat, collectors’ items or source material. Such as "What You Can Learn From The Kinsey Report," "Hilter's Inferno," "War of the Worlds," and "The Search For Bridey Murphy." The first smash hit, however, was "The Investigator," which was based on the famous McCarthy trials.

At any rate, these records (besides bringing in a first measure of fame to Frey's Audio Fidelity independent business) made enough money to enable him to launch Audio Fidelity, in 1953.

Frey's Audio Fidelity Stereodiscs: was the first commercial record reproduction company to be produced and marketed. It constituted a major development in phonograph records and the most significant change since the transition from cylinder to flat record. And it is an acknowledged fact that by putting his Stereodiscs on the market when he did, Frey forced the

www.americanradiohistory.com

Audio • May, 1962
BELL Model T-337 4-Track Stereo Tape Transport with 3-motor professional tape drive

Positive record interlocks and lighted indicators — assure correct operation by even inexperienced users. 

Integrated RP-320 stereo record/playback preamplifier, with carefully engineered circuit, assures professional-quality recordings. Complete facilities provided for precise adjustment of meter calibration, bias, record equalization. Mike inputs are conveniently located in front; with high-level inputs, outputs, stereo headphone monitor jack on rear panel.

Professional 4-track recording characteristics are assured with two-speed equalization-bias switching. 4-track stereo and monophonic, 18-15,000 cps ± 3 db @ 7½ ips; 18-15,000 cps ± 3 db @ 3½ ips. 50 db signal to noise ratio. (Also records 2-track stereo and monophonic with blank or bulk-erased tapes.)

Mounts in horizontal or vertical plane to fit every type of installation. Matches the Bell Amplifiers in styling and color, for a perfect decorator-approved custom installation. See your Bell Dealer NOW! Bell Sound Division, Thompson Ramo Wooldridge Inc., 6325 Huntley Road, Columbus 7, Ohio.

www.americanradiohistory.com
entire industry into an all-out stereo program. Audio Fidelity released its first Stereodisc (made by the 45/45 Westrex cutter) to the industry in November, 1957, to offer to the manufacturers a pure vinyl record that would last for months. This first Stereodisc (Audio Fidelity's own name for its stereo product) was offered free of charge to accredited members of the industry via a single advertisement in a trade publication. Needless to say, Audio Fidelity was deluged with requests.

The next move of the industry, now that it had such a record with which it could perfect cartridges, pickups, amplifiers, and so on, was to get it out on the market. And it was Frey who made it to market first. The first Stereodisc was offered to the buying public in February, 1958, at the West Coast Hi Fi show and also via a demonstration at Macy's in New York. And the Age of Stereo was launched.

Frey characteristically admits that his neck was stuck out. The Westrex cutter was so new that even at this point he doesn't hesitate to admit that all the bugs have not been totally removed. But he says, like the turtle, progress can only be made when you stick out your neck.

Not only is Frey fanatical about maintaining the very best standards possible in producing his records, but he feels most strongly that information given to the public should be completely correct, clear, and to the point. People should be guided to distinguish true stereo sound from faked or gimmicked stereo sound, so that the term "stereo" does not become an abused one and bandied about like "hi-fi."

Robert Furst

Furst seemed to have been destined to his final avocation from his early life on. He was born into a family where engineering had become a tradition. He grew up surrounded by the intellectual atmosphere of the post-World War I Vienna of Weingarner, Furtwängler, and Bruno Walter. He still recalls the many rain-drenched afternoons he spent under an umbrella standing in queue for a "Stehplatz" in the rear of the upper balcony of the Vienna State Opera. After attending the University for an engineering degree, he found himself, during the political upheaval of the late twenties transferred to Chicago, Ill., where he completed his formal education at the Illinois Institute of Technology.

In 1942, Furst joined the engineering staff of Majestic Radio and TV Corporation where he found himself quickly involved in a new "art," FM radio, first for military and later for home entertainment applications. Under the tutelage of Majestic's chief engineer, Dudley Foster (Foster-Seeley discriminator), one of the great pioneers of the early radio era, he gained first hand knowledge of the intricacies of FM. Significantly, Furst has been involved in FM tuners and music home entertainment systems ever since. In 1950, Furst joined the David Bogen Company as Assistant Chief Engineer where he made the acquaintance of Sidney Harman and Bernard Kardon. In 1952 he joined Harman-Kardon as Vice President, Engineering.

In the ten years of collaboration between Kardon and Furst, many intellectual designs have evolved, and hi-fi components have been brought out of the attic into the living room. The haywire "bucket-of-bolts" approach, acceptable to the small coterie of prewar specialists, has been replaced by sleek styling and simply organized controls that delight the homemaker. The Citation series based on a cost-no-object approach provides performance unequalled previously outside the laboratory. It is interesting to note, however, that the advances in tuners and amplifiers over the past twenty-five years have not been by virtue of startling breakthroughs, but by continual painstaking refinement. Frequency response of 20 to 20,000 cps now has been widened to 2 to 100,000 cps. Distortion has been pushed down to immeasurably low levels and phase shift, which previously was never even considered important, is now carefully controlled.

What of the future? Furst is up to his ears in a transistorization program and expects to spend the next few decades doing the thing he loves best, improving the quality of music in the home.

Peter C. Goldmark

Dr. Peter C. Goldmark was born in Budapest in 1906, and studied at the Universities of Berlin and Vienna, receiving his Ph.D. in physics from the latter in 1936. He was a professor in mathematics at University of Pennsylvania—AB 1940. U. S. Coast Guard 1942 to 1945 during which he had my first exposure to sophisticated electronics when I got an assignment as communications officer and was given responsibility for radar, loran, sonar, and radio equipment.

On return to civilian life found that the old hi-fi rig had expired and it was necessary to build a new one. This led to a long period of trial and error which led to partnership with Herbert Keroes in the formation of Acro Products. We started this transformer business in order to get a high-quality output transformer in order to make a good amplifier. At that time, the two of us wanted to produce amplifiers, but the transformer business turned out to be suffi-
MX-100. STEREO MULTIPLEX ADAPTER KIT. All critical circuitry factory-adjusted and prealigned. Maximum stereo separation between 20-15,000 cps, with low distortion. Stereo switch permits either front-panel separation control or maximum separation adjusted at factory. Kit: $49.95; Factory Wired, ready to operate: $69.95.

ST-26. FM TUNER/AMPLIFIER KIT. Low-cost combination but FM music system. Requires only the addition of external speaker (see L-3) to complete system. Pre-Built Front End fully adjusted and prealigned at factory. Kit: $24.95; Factory Wired, ready to operate: $69.95.


ST-35 MX. FM STEREO MULTIPLEX TUNER KIT. Designed for maximum sensitivity, selectivity and stability. Full, prealigned multiplex circuitry incorporated. Kit: $29.95; Semi-Kit: $119.95; Factory Wired, ready to operate: $139.95.

SA-40. STEREO PREAMP-AMPLIFIER KIT. 40 watts RMS (20 per channel). Stabilized feedback circuit insures optimum performance with all types of speaker loads. Harmonic distortion: less than 0.5% at 20 watts; 14 panel controls. Kit: $79.95; Factory Wired, ready to operate: $129.95.

FROM BOX...

TO BEETHOVEN IN 1/3 LESS TIME!

In timed, competitive tests, twin brothers — with twin backgrounds and skills — proved that Paco kits are faster, easier and more fun to build than almost-identical kits sold by other kit makers. They discovered that there’s no guessing with Paco: parts are neatly packaged and precisely labeled; instruction books are complete and easy to follow. Accurate drawings to actual scale and fold-out diagrams are printed right next to step-by-step directions. ■ The twins also proved that Paco pleasure doesn’t end with the wiring. The ST-25 MX FM Stereo Multiplex Tuner, for example, looks and performs like twice the price: frequency response is 30 to 20,000 cps within 2 db; sensitivity is 1.5 µv for 20 db quieting. It features self-contained, prealigned and fully shielded front end, FM Stereo multiplex circuitry, dual limiters, AFC with panel switch for AFC defeat and “eye”-type tuning indicator. Why not put Paco to your test. Kit: $69.95 net, (factory wired, ready to operate: $99.95). See your dealer or write today for details to Paco Electronics Co., Inc., 70-31 84th Street, Glendale 27, New York, a division of Precision Apparatus Company, Inc. Export: Merhan Corporation, 458 Broadway, New York 13, New York. In Canada: Atlas Radio Corporation, 50 Wingold Avenue, Toronto, Canada.

*AS PICTURED ABOVE

PACO KITS
THE KITS YOU BUILD IN 1/3 LESS TIME
Company. I decided to specialize in high fidelity kits because I had just spent six years dealing with amplifier builders and felt that I had not only absorbed their problems and viewpoint, but that I could offer them kits which would free them from the problems of hacking at chassis and debugging their own circuits. This has been my major activity since 1953 when the first Dynakit was produced.

I think that my contribution to high fidelity (some people may think that it is a negative contribution) is that I helped to popularize high power. This in turn made the low-efficiency speaker practical. This came about in two steps. The ultra-linear circuit, of which I am co-inventor, immediately doubled the power output of the popular triode circuits like the Williamson circuit. Then, the first Dynakit, the Mark II, was a 50-watt unit which brought this power range to a mass market. I think that my work has led to providing more watts per dollar throughout the high fidelity industry, and the result of exposing people to higher power has been to demonstrate that power required for good reproduction was greater than most people had realized.

H. A. Hartley

I was born in 1900 and I am a Scot. My first name is not Harold, although Esquire seemed to think so when it wrote me up a few years ago; the first Harold got an arrow in the eye in 1066, but I have the honour of a more modern and much better family name. True I have fenced with Gilbert Briggs from time to time, as Audio readers will have noted, but we keep the buttons on the foils, for we wouldn't like to hurt each other, and he did me the honour of writing me up in his Audio Blue Book articles, so I won't repeat the gristy story here.

It was as a result of work with the late H. C. Turner that the world's first so-called high fidelity speaker was created. In 1926 we thought we had done much better than our illusory contemporaries Rice and Kellogg and I thought lessingly called the sound of it "high fidelity", little knowing what that would lead to. The fact, was my most fabulous invention.

So far as actual technicalities are concerned, Turner and I jointly developed the first mid-cone resonant unit of the mid-century speaker. We not only devised the original spider washer but the only one that imposed no resistance to music. The voice coil was not only a non-resonant unit but that old device has never been improved on by anyone. Along with this went our free outer suspension which not only damped the free edge of the cone but imposed no restraint on its movement. Speakers incorporating this free suspension became the market leaders, as I have heard that some of those speakers are still working perfectly well in Britain today.

Our other original device was the Bakelite cone. In those days there was no hope whatever of moulding them and we made them out of flat sheet cut to shape and cemented. But to avoid creating a flat spot anywhere in the cone, our point was to make a complete revolution from apex to outer edge. So, although the outer edge was free it remained circular, essential if resonances were to be avoided.

In 1937 I made a step forward. After some heartbreaking experiments I managed to produce a non-resonant speaker fitted with moulded Bakelite cones in which the compound was almost pure resin. I demonstrated these at the Glade gow High Fidelity Fair in 1937 and everybody thought they were the most wonderful speakers that had ever been devised, and I still think so. Unfortunately the cone-producing technique was so chance that I couldn't go into real production, but the theory on which the made-up cones until the second World War put a stop to all our work, and during that war Turner died.

Meanwhile, as we had produced a non-resonant speaker it seemed to me desirable to produce a non-resonant enclosure, so I dreamed up the thing which came to be known as the Boffle and it was and is a truly non-resonant baffle. Since it became well known in the U. S. I have been asked whether it doesn't do for the speaker real credit, but it does. What it doesn't do is add false bass, and all the other enclosures and fancy cabinets which I have studied seem to me to fail because they are resonant.

I suppose I am an old-fogey purist, but it does seem to me that as a speaker in its enclosure has to make an attempt to reproduce every kind of musical noise, it must have no "personality" of its own. It must be absolutely unbiased; it must add nothing and take nothing away. The unit itself calls for vast experience of what does distort (since we can only approximate to perfection), and apart from mass of the moving parts (which impairs transient response), what must be avoided at all costs is resonances. I just don't believe that a resonance in the speaker can be neutralized by a counter resonance in the enclosure with any precision, so if one has a non-resonant unit it demands a non-resonant enclosure. Furthermore, the technological advice on how to build a Boffle for Radio Electronics, and I had a pile of letters from readers who said they had built Boffles for speakers with bass resonance and found the combination wondrous. In other words get rid of all the resonances.

Of course it reduces the apparent bass, but that brings up one of the toughest problems that can harass a high-grade speaker manufacturer. High fidelity does not imply powerful distorted bass that can shake the foundations nor synthetic top which goes through your head like a sword. It is an attempt to realize, and is not an impressive commodity at a High Fidelity Fair. I know, from experience of some in New York and London. Everybody means well, but it just isn't a "commercial proposition" to make any attempt to demonstrate real quality when others are bending the walls with distortion at +90 decibels.

When I was able to resume production of speakers in 1946 I couldn't obtain my old prewar Bakelite sheet (I originally got it from Germany), and at that time I couldn't get the special cement. Everybody else used felted paper, but the snag with that was that it didn't reproduce the high notes. I had the brainwave of introducing a midcone compliance with the idea of isolating the apex from the comparatively huge mass of the cone. I didn't know at the time, but later an inventor showed me a British specification in which he had had the same idea, but it fell down through the wrong technical approach. Mine did work, and the well-known Hartley 215 speaker was born. It was so successful that I was tempted to have a go at the potentially vast American market.

I had no idea how to start, but I examined all the American magazines and came to the conclusion that a rather slender one called Audio Engineering might fill the bill, my idea being that if I could interest the audio boys they would tell the general public. So January 1949 was for me a great moment, for my first foreign advertisement appeared in what is now Audio, and I met G. G. McProud and his quite delightful ads. I wrote my ads in a simple straightforward way, and sincerely believed to be true about the speaker, and the funny thing is that quite a lot of people believed it too and sent me their orders. I shipped them direct from London, real personal service.

The thing grew to such an extent that I took a chance on showing them at the 1951 Audio Fair. Hartley's comic column had appeared on the back page of Audio for two and a half years and it was pulling in the orders. I had earned enough to pay my way across, buy a room at the New Yorker Hotel, and do my stuff. It was a tough time. I arrived when one of the naval waterfront strikes was operating in New York and was warned that any attempt to clear my
The quality and versatility of custom sound with the installation ease of compact package equipment!

Introducing the Harman-Kardon Galaxy Series

More power, more features, more sales potential! Harman-Kardon has created a dramatic new concept in professional sound equipment—a modularized line with performance, flexibility and value unmatched in its price range. For the first time, you can offer amplifiers combining the quality and versatility of custom sound with the installation ease of compact, packaged equipment. Now you can sell your customers sound that precisely fits their present needs, easily expands or modifies for future developments and never becomes obsolete. All this at attractive, competitive prices.

Choice of 40, 75 and 150 watt amplifiers and power boosters. Also 8-channel mixer-preamplifier and a wide choice of easily installed preamp modules with multiple inputs for every type of program source—including some modules with facilities for precedence and compression operation. The first truly exciting development in decades, the Galaxy leads the way in the achievement of important new techniques for the sale and installation of custom sound. Get the full story; write for catalog: Desk 5B, Commercial Sound Division, Harman-Kardon, Plainview, L. I., New York.

Just a few features found on the GALAXY Series: Remote control of level, AC power and standby operation; Monitor jack as well as optional monitor speaker or Vu meter; Constant voltage outputs, both balanced and unbalanced; Bridging connections; Low Cut Filter, Speech Filters; NARTA Mic Inputs; All plug-in accessories; Response and distortion specs that satisfy the most stringent requirements.

Built by Sound Men for Sound-Men

Harman Kardon
goods would mean broken heads. But I pay my tribute to the Customs officers. We unpacked the stuff in the customs sheds, had it checked, put it in crates which were laid on the floor of taxis and got away in safety. Those Customs men were real guys! And that was the beginning of the Hartley era in the United States. It was never a big market but it was a loyal one, and brought me many friends. My enormous mall gave me a greater insight into what makes America tick than could have been derived in any other way. And it all started from that first ad in Radio.

I sold my London business in 1953. I was never a routine worker. I wanted to create, design, innovate, and that was getting bowed down by the daily chores. The personal touch had gone, and so had the high fidelity. Of course, in the last count, we are all overwhelmed by the daily chores. I thought it sounded okay, and it was a genuine Hartley speaker was sold in 1953.

Hartley Zone that time I have been brooding on the shape of high fidelity to come. In between writing books and other ways of keeping the wolf from the door I keep on working in my English laboratory. I reckoned my wife's hi-fi phonograph four years ago because I thought it sounded okay, and she keeps on nagging me as to when she'll get another. Maybe she will sometime this year, for I think I am beginning to see daylight. For some time I have instinctively felt that hi-fi as we know it is played out. The kick we enthusiasts derive out of it isn't there; there has become the inevitable accompaniment of the café society, beatnik, and ordinary ways of living. I'm not trying to be snotty; everybody is entitled to a hi-fi outfit, but to my ears it isn't a musically real outfit. I don't blame the manufacturers; the bigger they get the more remote becomes the "touch of the master." The stuff isn't there, therefore it is not a musical performance by the producers of tape and discs. They do pretty well, but I would like them to do better, and, as how the manufacturers decided, I'm not trying to be snotty; everybody has a right to a weekend for money in a material sense. Of course, in the last count, we are all at the mercy of the producers of tape and discs. They do pretty well, but I would like them to do better, and, as how the manufacturers decided, I'm not trying to be snotty; everybody has a right to a weekend for money in a material sense. Of course, in the last count, we are all at the mercy of the producers of tape and discs. They do pretty well, but I would like them to do better, and, as how the manufacturers decided, I'm not trying to be snotty; everybody has a right to a weekend for money in a material sense.

Arthur A. Jansen

I was born in corn and cotton country in Texas, on a rolling prairie near Yoakum, nearly fifty-five years ago. In 1912 I decided to leave home for good and make my own way, but I changed my mind about the road and the horse. When my parents picked me up hot, tired, and hungry, I thought it might be a good idea to visit until I was at least six. Actually, I didn't leave again for fifteen years. In that time we moved from a relatively gentle community into a frontier area near the King Ranch's feudal domain, a hundred miles from the Mexico border.

High school education began when I enlisted in the U. S. Navy for four years, "to see the world." My travel expectations, seemingly justified since I was a recruit poster of that time, were thwarted by President Hoover, who apparently thought it more important to save the country than to send ships around the world for the purpose of subjecting foreign coastal populations to the amenities of ownership. Well, I am clear that the battleship I was on, the U. S. Wyoming, wasn't going to travel, I transferred after a year to the Balboa, Panama Canal Zone radio station.

After Balboa, I spent an enchanting year on a three-man radio station on the rain forest on the southern shore of the Isthmus of Panama, near the Colombia border, at a village named La Puna. The facilities were complete, the utility (euphemism for entertainment) squadron at the Naval Air Station, Coco Solo, Canal Zone. Our function of supplying transportation for visiting important persons to and from points of non-military interest around the Canal Zone, was consumed. The station was a "catch-all" for everything military. We were the only large radio station of our kind around. We had to help out. While still at home, I had built and sold a number of battery-operated radio receivers prior to 1926, for any kind of portable or personal use.

While still at home, I had built and sold a number of battery-operated radio receivers prior to 1926, for any kind of portable or personal use.

I am not the type to indulge in long-winded statements of what went on in World War II, but suffice it to say that I served on two radio vessels, the U. S. Wyoming and the U. S. Wyoming Sounding Vessel. My travel opportunities were limited, but it is not the travel that is important. It is the people you meet on the road that are important. I am not the type to indulge in long-winded statements of what went on in World War II, but suffice it to say that I served on two radio vessels, the U. S. Wyoming and the U. S. Wyoming Sounding Vessel. My travel opportunities were limited, but it is not the travel that is important. It is the people you meet on the road that are important.

Arthur A. Jansen

I was born in corn and cotton country in Texas, on a rolling prairie near Yoakum, nearly fifty-five years ago. In 1912 I decided to leave home for good and make my own way, but I changed my mind about the road and the horse. When my parents picked me up hot, tired, and hungry, I thought it might be a good idea to visit until I was at least six. Actually, I didn't leave again for fifteen years. In that time we moved from a relatively gentle community into a frontier area near the King Ranch's

Dr. Hilliard is a Fellow of IRE, Acoustical Society of America, Audio Engineering Society, and Society of Motion Picture and Television Engineers. He is a member ofEta Kappa Nu Engineering Fraternity, Armed Forces Committee on Hearing Bioacoustics, Institute of Environmental Engineers, and AIEE. He is also an Acoustic Consultant for the Brain Institute, U.C.L.A. Medical School. He received the John H. Potts Memorial Award for outstanding achievement in the field of audio engineering in 1961.

He has published 60 papers in IRE, SMPTE, Electronics, Acoustical Society, and Journal of Environmental Engineers.

Dr. John K. Hilliard

Dr. Hilliard received his B.S. degree from Hamline University in 1924, following which he did graduate work in electrical engineering at the University of Minnesota. He received a D.Sc. in Engineering from Hollywood University.

Dr. Hilliard's experience includes eighteen years with MGM Studios working on the development of recording and reproducing telephone and tape equipment and the design of microphones and loudspeakers for theaters. He was Project Engineer at the Radiation Laboratory, Massachusetts Institute of Technology, on radar. He has spent seventeen years with Altec Lansing Corporation as Vice President, Advanced Engineering Department. Dr. Hilliard included the development of transducers, communication equipment, and high-intensity sound environmental equipment to simulate jet and missile engine noise to evaluate fatigue of electronic equipment and airframe structures; microphones to pick up heart sound; communication equipment for telephone systems; and anti-submarine warfare equipment.
Here is unbelievably excellent sound quality combined with the ultimate in placement flexibility. Compact size (12⅝" H, 15⅝" W, 2⅝" D) takes little space on desk, table or shelf. The slim-compact X-20 is ideal for wall mounting with built-in brackets. Finish is oiled walnut. Convenient volume control on the side. There's a refreshing decorator touch in the two-tone harmonizing custom fabric on the front. 3 speakers—a woofer and 2 tweeters—provide smooth wide range sound. Perfect for FM Multiplex, very low cost stereo, other-room extensions.

X-20 3-speaker 2-way system. Impedance, 8 ohms. Power rating, 6 watts. Adequate room sound with 1 watt to speaker.
In Oiled Walnut .... $39.95

X-10 2-speaker 2-way system. Impedance, 8 ohms. Power rating, 6 watts. Adequate room sound with 1 watt to speaker.
In Oiled Walnut .... $29.75

Jensen Manufacturing Co., 6001 S. Laramie Ave., Chicago 38, Ill. / Canada: Radio Speakers of Canada, Ltd., Toronto / Mexico: Universal De Mexico, S.A., Mexico, D.F.
Assistant in the Acoustics Research Laboratory.

At the Acoustics Research Laboratory, in connection with the projected measurement of the transient response of a microphone array, the investigation of the transient response of a receiving array could not be undertaken without a prior development of a suitable sound source. Electrostatic transducer was chosen for the source.

New materials had become available since electrostatic loudspeakers dropped out of sight in about 1932. By 1953, the first push-pull, full-range electrostatic loudspeaker capable of producing high acoustic pressure levels had been developed, and an experimental model was shown during a meeting of the American Physical Society in Cambridge, Mass., in January of that year.

In 1954, the Magnetic Amplifier Corp., of Waltham, Mass., became Janszen speaker (mid and high frequencies) was completed, and production began in May of that year. The results of a series of tests indicated that a loudspeaker capable of producing high acoustic pressure levels had been developed, and an experimental model was shown during a meeting of the American Physical Society in Cambridge, Mass., in January of that year.

In early 1959, the first production models of the full-range electrostatic loudspeaker, now being manufactured and sold by the Klh Research and Development Corporation as its Model Ninety, were delivered. Protopses had been placed in the field during 1957 and 1958.

During 1959, the assets of Janszen Laboratory were transferred to the Klh Research and Development Corporation, of Cambridge, Mass., and I became a stockholder and a vice president of Klh. My activities include the development of new industrial and home-entertainment products, product engineering, and general administration.

My family and I live in Belmont, Mass., just beyond the Cambridge boundary. My wife, Pearl, and I have three lovely children named David, Karen, and Eric, whose ages are 6, 8, and 4 years respectively.

Member of the Acoustical Society of America and of the American Association for the Advancement of Science.

Bernard Kardon

Music—its storage and recreation—is the basis for the hi-fi industry. This fundamental fact is sometimes submerged under a flood of claims, but Bernard Kardon has never lost sight of it. Reproduction of the emotional content of tone music, as well as its structural form, has been his guiding force during his many years in the industry.

Bernard Kardon was born in 1914 in New York City, the third of five children. His parents had an unusual combination of music interest and engineering talent. His mother, whose main interest other than her family was the piano, exposed each of her children to a fundamental education in music. His father, one of the original members of the legendary Bronx Radio Club, was a pioneer in broadcast engineering, producing stamped circuit tuners and amplifiers as early as 1920.

Kardon was first introduced to his life's work by his father's plant. Formal education at technical schools (Stuyvesant High School and Cooper Union) was supplemented with practical experience, first as a radio repairman and later as an engineer. An early marriage (the Kardons' will celebrate their 25th anniversary this year) was a settling influence.

In 1937 he entered the employ of the David Bogen Company as a design engineer, later becoming chief engineer, a post he held through World War II. In 1940 he left the post of president of Janszen, Inc., the predecessor of Harman-Kardon, Inc.

In 1950 he left the post of Executive Vice President of that company to start the predecessor of Harman-Kardon, Inc., a company that deeded around sound systems in the then-new talking movies and for schools. For a long time there was no general public interest in hi-fi, but a small number of recording engineers and musicians were assembling systems in their own homes, selecting the better components wherever available and modifying them to suit.

Kardon found that a large part of his time was spent modifying and calibrating special versions of PA equipment for these specialists. Before long it became obvious that specially designed equipment was needed to satisfy the market. It was a labor of love, and required research into basic questions cutting across physical, psychological, and physiological boundaries.

The war years interrupted this work. His time was devoted to producing equipment for the Armed Forces, and so he found that a large part of his time was spent modifying and calibrating special versions of PA equipment for these specialists. Before long it became obvious that specially designed equipment was needed to satisfy the market. It was a labor of love, and required research into basic questions cutting across physical, psychological, and physiological boundaries.

The post-war years brought an explosive growth in home entertainment via electronics. FM broadcasting, LP records, tape recording, stereo records and lately, multiplex FM stereo has caught the public interest. Now he occupies his time planning new projects and guiding the overall engineering investigations on a broad base—away from the daily responsibilities of management.

Paul W. Klipsch

Paul Wilbur Klipsch was born on March 9, 1904 in Elkhart, Indiana. He received a B.S. degree in electrical engineering from New Mexico State University, University Park, N.M., in 1926, and the degree of Engineer from Stanford University, Stanford, CaL, in 1934.

He was employed in the testing department of the General Electric Co., from 1926 to 1928; the Anglo-Chilean Nitrate Corp., Tocopilla, Chile, from 1928 to 1931; the Independent Exploration Co., Houston, Texas, from 1934 to 1936, the Subterrex Co., Houston, from 1936 to 1941; the U. S. Army Ordnance Dept. At present he is the owner of Klipsch and Associates, Inc., Hope, Arkansas, manufacturer of loudspeakers.

He is a Fellow of the Audio Engineering Society, a Senior Member of IRE, a member of AIEEE, the Acoustical Society of America, Tau Beta Pi, Eta Kappa Nu, Sigma Xi. He is a licensed professional engineer in Texas and Arkansas. He is also a member of Scimitar Temple (Shrine), the Sojourners.

“My first loudspeaker was a cardboard
just for the record
the NEW RONDINE 2 has added an extra motor

REK-O-KUT, maker of the world's finest turntables, combines the superior quality of single play turntable with Auto-Poise — the first motor-actuated tonearm. To achieve this unique record playback system, REK-O-KUT designed this unit with two motors, each of which performs separate functions. One motor drives the turntable quietly at a constant, accurate speed. The second motor actuates an electromechanical device which, at the press of a button, places the tonearm on the record at one gram force, removes it automatically at the conclusion of the recording, returns it to the arm rest, and shuts off the turntable. From the first groove to the last groove of your record, Auto-Poise is disengaged and the tonearm is completely free-floating and independent. If you want turntable perfection, distinctive styling, unequaled engineering and workmanship in a single compact factory-assembled unit that will fit any cabinet, then the RONDINE 2 is for you. Ask your dealer for a demonstration or write for free descriptive literature.

Model R-320A 33½ rpm Turntable with Auto-Poise motor actuated tonearm $169.95
Model R-320 with S-320 Tonearm $129.95
Model R Turntable only $79.95
Model R Base $14.95

REK-O-KUT COMPANY, INC.
DEPT. A-5, 38-19 108 ST., CORONA 68, N.Y.
"born" attached to a Brandes Superior earphone in 1920. It was a far cry from that to the dihedral corner horn of 1940 and from there to the Klipschorn of the present day.

"Adherence to basic physics has resulted in designs of a durable nature. There have been no 'breakthroughs' experienced along the way. The result has been the production of speakers which have negligible obsolescence."

Harold J. Leak
Mr. Harold J. Leak, M.Brit.I.R.E., was born in 1907. He has spent his life interested in and contributing to technical advances which have resulted in the highest quality of sound reproduction. In contrast to his modern laboratory in which he works, he lives, with his wife, two sons and daughter, in a beautiful 15th century house in the countryside a few miles out of London. He is a keen angler and a bird-watcher, being particularly interested in bird photography.

His interest in radio started while he was in high school, and was subsequently honed by being a Fellow of the Audio Engineering Society; a Member of the Acoustical Society of America; an Active member of Society of Motion Pictures & Television Engineers; and a Fellow of the Radio Club of America. Books he has authored are "Fundamentals of Magnetic Recording" and "How to Make Good Tape Recordings" both published by Audio Devices, Inc. and both best sellers.

Impingement of LeBel on Audio Field:
At Raytheon his first patent has since turned out to be one of fundamental patents with the fluorescent lamp (the much bigated "LeBel Patent"). All audio products are built under fluorescent lamps.

At Audio Devices LeBel was active in the first automatic machine production of lacquer recording blank discs in America, and in American application of these discs. Audio Devices rose from "nothing" to the largest American maker of lacquer discs in one year and still is the largest. He supervised development of the first Audiotape magnetic recording tape. He also helped write many sound recording standards.

At the Maico Company LeBel applied psychoacoustics to hearing aid design. Surgeons here, at last, got that they believed write the first standard on methods of measuring performance of hearing aids and developed the Maico Stethotron, the first really successful electronic stethoscope.

At the Audio Instrument Co., Inc. LeBel developed an intermodulation meter with extremely low internal leakage, capable of reading very low values.

From 1937-1942 he was Chief Engineer and from 1940-now, Vice President, of Audio Devices, Inc. where he worked on lacquer recording blank discs and magnetic recording tape. From 1942-45 he was Chief Engineer of the Maico Company working on hearing aids, hearing test equipment, electronic stethoscope and a hearing aid prototype. In 1945-46 he was a Project Engineer at Cambridge Instrument Co., working on hearing aids and electronic stethoscopes. In the years 1946-47 he worked as electronic consultant. Damage Control Project, at Stevens Institute in a study of ships' motion. Finally, from 1947-now he has been Chief Engineer of Audio Instrument Co., Inc.


Mr. LeBel is a Fellow of the Audio Engineering Society; a Member of the Acoustical Society of America; an Active member of Society of Motion Pictures & Television Engineers; and a Fellow of the Radio Club of America.
Another exciting hi-fi development from PIONEER: the PT-P1 pleated tweeter. A look at the characteristics of this new tweeter will show you that the differences between it and ordinary paper cone and unpleated diaphragm tweeters are truly important ones.

1. Absolute stability in characteristics and tone quality - ideal for stereo.
2. Superb frequency and directional characteristics.
3. Frequency characteristics and tone quality equivalent to those of horn tweeters.
4. Because of low crossover frequency, it offers a dynamic mid-range even in a 2-way system.

Also, see PIONEER's high-performance "C Series" woofer - the perfect mate for the PT-P1.

UNIQUE TWEETER DIAPHRAGM!

High-performance tweeter PLEETER PT-P1

SPECIFICATIONS
V.C. Impedance 8 or 16 ohms
Frequency range 2,000 - 16,000 cps
Power input 20 watts
Sensitivity 104 db/watt
Total flux 21,000 maxwell
Flux density 13,500 gauss
Crossover frequency over 3,000 cps

PIONEER "C Series" woofers with powerful magnetic circuit

PW·25CPW·30CPW·35C
Resonance frequency 40 - 55 cps 35 - 50 cps 30 - 45 cps
Frequency range 35 - 4,000 cps 30 - 4,000 cps 30 - 3,000 cps
Power input 15 watts 20 watts 30 watts
Sensitivity 103 db/watt 105 db/watt 107.5 db/watt

DISTRIBUTORS:
U.S.A.: Pety Enterprises, Inc. 300 Park Avenue South, New York 10, N.Y.
Canada: Importhouse of Canada. 2939 Eglinton Avenue East,Scarboro,Ontario
Malaya: Hwee Seng & Company. 259 Beach Road, Singapore 7

PIONEER ELECTRONIC CORPORATION
5 Oiowacho, 6-chome, Bunkyo-ku, Tokyo, Japan

AUDIO • MAY, 1962
of 1 M. This has been improved year by year; present leakage is 0.015 per cent (just fine for measuring 0.1 per cent distortion). Subsequently he developed logarithmic amplifiers (loggers) which are used to convert linear recorders to a db scale. These utilize a highly developed and patented instant acting variator converter. A magnetic tape time delay recorder was his next development, using sliding heads to adjust delay time. Used to solve echo problems in auditoriums or theaters with balconies, by use in conjunction with public address systems.

Frank H. McIntosh

We entered into the audio amplifier business and the associated hi fi field through the need for a better product we required in connection with a musicfor-industry operation in Cincinnati, Ohio. After the war, we discovered great difficulty or impossibility of making purchased amplifiers perform according to their own specifications. As a side line to Consulting Radio Engineering, we investigated the feasibility of developing an amplifier which would perform across the entire audio spectrum first without an output transformer, then, as the facts of life became more evident with an output transformer which would be efficient and do the proposed job. First we made a standard push-pull amplifier which put out 50 watts—-which required six tubes. It was operated almost Class A and it weighed nearly 125 lb. but delivered the required power. This didn't seem very practical as almost no one could lift it, let alone afford it.

The next procedure was to utilize the multiplier circuit not generally used in audio systems which meant higher efficiency and there-

There were several advantages to this circuit which we at first did not fully appreciate. As designed initially it was capable of unbelievable bandwidth operation and provided 50 watts from a pair of 6L6's at less than 1 per cent distortion at any frequency from 20 to 20,000 cps—performance far beyond anything yet made for commercial use. Even today this is better than many audio amplifiers available. This was a 1949 design and the result of three years of development and a dollar investment of six figures. Gordon Gow, Vice President and General Manager of McIntosh was a major factor in the early development and Sidney Corderman, Director of Engineering has made the modifications since the first development of this circuit.

It was first thought that this amplifier would not be a factor in the audio field as it was felt its superior performance would not be noticeable in actually listening but we were wrong and its performance became one of the turning points of improved quality and standards. We hope it has helped to advance the art toward the perfection of sound reproduction.

Robert Newcomb

Newcomb Audio Products Co. was organized 25 years ago by Robert Newcomb. His purpose was, and still is, to offer the sound-equipment user the best quality of sound products. He was among the first, if not actually the first, to use inverse feedback in commercial amplifiers. Newcomb amplifiers have earned a national reputation for reliability. Newcomb was early in offering compact design styling to the hi fi trade, as well as being early with true remote control, and the first to offer plug-in input transformers.

The line now includes both 1/4-track and 1/2-track stereo recorders of high performance with cybernetic design for ease of operation of the transport. The company is still owned and directed by its founder Robert Newcomb and continues to be dedicated to quality.

Dr. Harry F. Olson

Dr. Olson received the B.S., M.S., Ph.D., and E.E. degree from the University of Iowa, and an Honorary D.Sc. degree from Iowa Wesleyan College. He has been affiliated with the Research Department of Radio Corporation of America, the Engineering Department of RCA Photophone, the Research Division of RCA Manufacturing Company, and RCA Laboratories. He is Director of the Acoustical and Electromechanical Research Laboratory of the RCA Laboratories.

Dr. Olson is a past president of the Audio Engineering Society, past president of the Acoustical Society of America, and past chairman of the Administrative Committee of the IRE Professional Group on Audio. He holds more than 90 U. S. patents. He is the author of 85 papers and the books "Elements of Acoustical Engineering," "Acoustical Engineering," "Dynamical Analogies," and "Musical Engineering."

Dr. Olson has received the following honors: The Modern Pioneer Award of the National Association of Manufacturers, the John H. Potts Medal of the Audio Engineering Society, the Samuel L. Warner Medal of the Society of Motion Picture and Television Engineers, the John Scott Medal of the City of Philadelphia, and the Achievement Award of the Professional Group on Audio of the Institute of Radio Engineers.

Dr. Olson's pioneering work in the development of gradient bidirectional and unidirectional microphones with uniform directivity patterns started in the late twenties. These microphones demonstrated immediately outstanding efficiency in discrimination against noise, reverberation, and other unwanted sounds. As a result, gradient directional microphones have been universal since that time in all applications of high fidelity sound pickup.

In the late twenties Dr. Olson pioneered in the development of high-efficiency, large-throat, cone-driven, horn loudspeakers. Since that time this type of horn loudspeaker has been used for reproducing the entire audio frequency range and in combination with small-throat horn loudspeakers for reproducing the low-frequency range.

He was responsible for demonstrating that direct-radiator loudspeakers employing a double voice coil and other expedients could reproduce the entire audio spectrum. He also demonstrated that uniform directivity with respect to frequency could be obtained from direct-radiator loudspeakers by employing cones graduated in inverse size with respect to the frequency. In the late thirties he developed a low-resonant, high-frequency, loudspeaker employing folded edge or accordion suspension.

54

AUDIO • MAY, 1962
A clock or watch is undoubtedly more convenient for telling time. Yet, it is actually possible to keep accurate track of time with a hysteresis motor-driven Miracord turntable. The speed of a hysteresis-synchronous motor is precisely regulated and timed by the frequency of the line current. This speed is constant even with variations in line voltage and load. Consequently, a hysteresis motor-driven turntable will rotate at the precise record speed, and maintain that speed regardless of voltage fluctuation, or the number of records on the platter.

The Miracord 10H uses the famous Papst hysteresis motor with the outside rotor. It's the same motor employed by the finest professional turntables and tape transports. The external rotor is a dynamically balanced mass. As it spins, it acts as a flywheel, further smoothing and evening out the motion of the turntable.

You can see this flywheel effect with the turntable platter removed. After starting the motor by lifting the arm from its rest, you let it run for about 10 seconds. You then shut the power off, by replacing the arm. The rotor will continue to spin by the sheer momentum of its own mass for at least 20 to 30 seconds. Most motors will stop in about 3 seconds.

The Miracord is the only record playing instrument with hysteresis motor, dynamically balanced turntable and mass-balanced transcription arm which you can play manually, or as automatically as you please. The Miracord is also available with 4-pole induction motor—the Model 10, priced at $79.95. The Miracord 10H with hysteresis motor is $99.50. Prices include arm, but are less cartridge and base.

Make it a point to see the Miracord at your high fidelity dealer soon. For details, write to:

BENJAMIN ELECTRONIC SOUND, INC. 97-03 43rd AVENUE, CORONA 68, NEW YORK. SOLE U.S. DISTRIBUTOR FOR ELECTROACUSTIC RECORD PLAYING COMPONENTS
The mechanism operated in a small closed cabinet in which the compliance of the air in the cabinet provided the controlling acoustical impedance in the low-frequency range. This was the first commercialized system employing this principle for obtaining low distortion which has since become widespread in use in high fidelity small-inclosure loudspeakers.

During World War II he was engaged in the development of sonar and other systems for antisubmarine warfare.

Dr. Olson developed the first active type sound absorber: employing an electronic system for cancelling out or absorbing unwanted sound or noise. Several experimental applications have been made of this system, as for example, the reduction of noise by an air conditioner.

With Mr. Belar they developed the RCA Electronic Music Synthesizer which can produce from a coded paper record any audible sound whatsoever regardless of whether it has been produced before or not. The RCA Electronic Music Synthesizer is now used by Columbia and Princeton Universities for the production of electronic music.

Mr. Poniatoff started Ampex with six employees working in the loft of a furniture shop and today the company has 4500 on its payroll. I think you will agree that this is a remarkable 18 years' achievement. This has been done without sacrificing technical standards (it is of course a fallacy to assume that big business always means mass production and price cutting). It is interesting to note that A. M. Poniatoff named Ampex with his own initials plus "ex" from excellence.

In addition to the tape recorders for which they are so well known, the company makes recorders for scientific instrumentation and computers, for missile centres, flight tests and space travel, automation, heart beats, brain waves and muscle vibrations. (So far as I know, there is no official recording of Mr. Poniatoff's original brain wave in 1946, when he mastered the mysteries of the German Magnetophone.) I will not enlarge on the subjects of flight tests and space travel as these are very much above my head.

Last but not least is the fabulous Videotape recorder, which records vision and sound on magnetic tape at the very reasonable speed of 15 ips, ready for TV transmission immediately after recording. Its introduction in April 1956 touched off a revolution in television. Within a few days, Ampex received orders for 100 machines at $45,000 each.

Here is what Mr. Poniatoff has to say about the beginning:

"Magnetic recording as it was developed in Germany by Telefunken during the World War II (under the name of Magnetophone) was brought to the attention of several companies in the United States as a possible new product. The general reaction was that the equipment was not practical and would not: have any future due to the fact that it was very cumbersome and the tape was moved through a very long path including the head, tension, idlers, and so on. Furthermore, the tape could be broken at any time and this would be very serious, especially where the record was used for professional recording service in the future.

"When the first units were constructed, the radio stations were not willing to take a chance and put a program on the air recorded on a magnetic recorder for the reason I mentioned above.

"At that time, Bing Crosby had an opportunity to listen to our unit and he recognized the high quality of the reproduction as compared with the discs which were used up to this time by all radio stations. Under his pressure, and on his programs, our first unit were used on the air.

"During our first demonstration of the Model 200 in New York, the top technical experts of the radio and recording industries were gathered to evaluate the quality of our equipment. Our representa­ tive was at the age of 18 for demonstration purposes arranged an orchestra in a separate studio and sound was brought into another studio for the listeners with an A-B switch in their hands. On one position of the switch they were listening to the orchestra through the recording system. On the other position of the switch, they were listening to the orchestra after it was recorded and instantaneously played back to them. The position of the switch giving either direct sound or recorded sound were unknown to the audience. Our representative, knowing that in the past where discs were used the radio stations suffered from loss in the area of high frequencies, equalized the playback of our unit in such a manner that the high frequencies were slightly below the equal to that of normal. All the listeners unanimously stated that they knew which position would give them direct sound and which was recorded. Special remarks were made that a group of experts which was present had made expectations between recorded and directly played music. Obviously, they were mistaken in selecting the position of the switch and everyone listened to the music.

"This was the beginning of the new era in magnetic recording of major radio networks in the United States.

(A This section from "Audio Biographies" by G. A. Briggs.)
Only these FM Stereo Receivers have Pilot's unique signal-sampling multiplex circuit

You get the best possible FM Stereo reception because Pilot's unique signal-sampling multiplex circuit gives you maximum separation (30 db or better) across the entire audio spectrum. It is the simplest, most effective, most trouble-free circuit presently being manufactured for stereo demodulation. There are no troublesome frequency separation filters and matrices or extra controls as are required by other multiplex circuits. This is just one of the many features that make Pilot Stereo Receivers the perfect electronic "heart" for your high-fidelity system.

Patent Pending

PILOT 602M...30 watts music power...frequency response 20-20,000 cycles, ± 1 db...harmonic distortion 1% at full power...12-control flexibility...FM sensitivity 3 uv IHFM...wide band RF and IF circuits for undistorted reception at full modulation...6 inputs...5¼" high x 14¾" wide x 10¼" deep. With cover...
(Also available with added AM as Model 602S. Complete, 299.50)

249.50

PILOT 654M...60 watts music power (IHFM mid-band rating)...frequency response 10-50,000 cycles plus 0.5 db or minus 1 db...hum and noise: completely inaudible (80 db below full output)...intermodulation distortion: less than 0.3%...14 controls, including rumble and scratch filters...6 inputs...plus a fully automatic stereo indicator that lights on stations broadcasting FM stereo...5¼" high x 14¾" wide x 12¾" deep. Black and brass styling. With cover...

329.50

PILOT RADIO CORPORATION, 37-44 36TH STREET, LONG ISLAND CITY 1, NEW YORK
ized high-fidelity tone arm known as the Auto-Poise.

Mr. Silber was one of the prime movers in the founding of the Institute of High Fidelity Manufacturers in 1956, and its first president. His term of office as president extended from 1956 through 1959. In 1960 he was Chairman of the Board of Directors of the Institute. He has been a member of PACE since 1935 and is now a member of its Board of Directors.

Walter O. Stanton

Walter O. Stanton was born in Canton, Ohio and studied Electrical Engineering at Wayne University. Following college he joined the Electronic Control Corporation, one of the first companies to apply electronics to the now widespread field of industrial automation. Continuing to specialize in that field he became Vice-President and Chief Field Engineer of the Detroit Universal Duplicator Company where he developed and patented an electronic servo system which enabled any standard machine tool to produce complex contoured machined parts automatically. Immediately thereafter and for a period of five years he was associated with Control Instrument Company, Inc., now a Burroughs division, as Assistant Vice-President in charge of Engineering. Control Instrument Company specializes in fire control systems, servo applications and automatic control devices. He joined Pickering and Company, Inc., in 1948, and has served as Chairman and President since 1950.

In addition to patents granted, Mr. Stanton has been responsible for component and systems developments in the fields of automation, fire control, and audio, including the invention of the Fluxvalve and stereo Fluxvalve Pickups. Mr. Stanton was President of AES in 1957 and served four years as a Governor. He is currently Vice President of the Institute of High Fidelity Manufacturers.

Edgar Villchur

Indicating his well organized (and modest) thought processes, Ed Villchur presented his biographical information as follows:

1. 1951–1956 instructor in electronics and audio reproduction, NYU Division of General Education.
4. 1956 awarded U. S. patent No. 2,775,309 on acoustic suspension speaker system.
5. 1958 applied for patent still pending on hemispherical direct radiators used in AR-3.
7. Currently President and Director of Research, Acoustic Research, Inc.

Paul Weathers

Paul Weathers is well-known and respected in the audio industry for his many contributions to the art and especially for his remarkable FM phonograph pickup. However, few people know the extraordinary background of this quiet and unassuming man.

Mr. Weathers received his education in electrical engineering at Indiana and Purdue Universities. In 1929 he was employed by the Radio Corporation of America, and thus began an association which lasted until 1945. Mr. Weathers' first duties with RCA were in the field of sound motion pictures. Then followed the years of research and development in the allied fields of public address and sound reinforcement and industrial electronics.

Mr. Weathers was responsible for many developments during this period. Among his more noteworthy accomplishments were an automatic beverage inspection machine for Coca-Cola and other bottled beverages, a machine for the detection of contamination and other imperfections in milk bottles, the development of new techniques in large screen television for use in theatres and improvements in theatre sound equipment.

He developed new sound equipment for the New York and San Francisco World's Fairs, developed the first multiple antenna distribution system for radio and television now in operation in Rockefeller Center in New York, and made many contributions to phonograph reproducing equipment. Mr. Weathers left RCA as Product Manager of the Sound Department, but was retained to conduct development work in industrial and tape recording.

In April, 1950, Mr. Weathers formed his own company, Weathers Electronic Industries, in Collingswood, New Jersey. The company's original business consisted of an engineering product design and development service for the electronic industry and the production of audio amplifiers for electronic organs sold by the Allen organ company.

In June, 1950, Mr. Weathers gave a technical paper on a new type of phonograph pickup. Instead of the usual piezo-electric or magnetic type of cartridge, his pickup was a frequency modulation unit—in essence a miniature FM transmitter, employing an oscillator and demodulator in the circuit. Because the stylus in the cartridge merely traced the lateral modulations in the recordings, rather than performing any mechanical work which resulted in electrical impulses, the cartridge and the associated specially designed arm was capable of tracking at the stylus force of one gram. Several design changes were made and at the conclusion of successful tests it was decided that the unit was ready for commercial exploitation. In 1953, the company was incorporated and capitalized to finance the new production and sales activity.

In 1955, Weathers Industries entered the loudspeaker field with an ultra compact design. This was followed with designs for very-high-power loudspeakers having very high efficiency.

In 1958, Weathers Industries entered the turntable field with a new approach to the problem of maintaining a high degree of speed accuracy, free of annoying flutter, wow, and rumble. This turntable was driven by a very small hysteresis-synchronous motor only slightly larger and more powerful than an electric clock motor. The entire motor board assembly was floated on springs tuned to a very low sub-sonic frequency to eliminate acoustic feedback and jarring of the tone arm and pickup due to heavy footsteps on highly compliant flooring. This new turntable principle has stood the test of time and usage.

Paul Weathers is known in the high fidelity field as a practical perfectionist who doesn't develop new ways for doing things just to be different but to be different and better. His liking for the high fidelity industry is so great that he has never missed exhibiting in a major audio show since 1951.

W. W. Wetzel

Dr. W. W. Wetzel, divisional vice president of the magnetic products division of the 3M Company, St. Paul, Minn., helped father the sound recording revolution and has supervised its growth into an industry which impinges on the lives of all Americans.

The 3M Company first became involved in magnetic product development in 1944 when the Magnetic Development Co., under a military contract, arranged

(Continued on page 72)
THE NEW ELECTRO-ACOUSTIC...

Records show no discernible wear, keep their fidelity through hundreds of playings on this unique player.

Tracks at less than 3 grams... the 4-speed Electro-Acoustic 7000 series stereophonic record player with diamond stylus is certified to apply less than 3 grams tracking pressure. Your fine recordings show no discernible wear or tonal deterioration even after years of playing. Its laboratory-tested pickup maintains perfect fidelity and incomparable realism throughout the entire recorded range.

The dynamically-balanced 4-pole, 4-coil motor and turntable, the micro-honed motor spindle, precisely machined bearings, and the custom-fitted turntable drive limit rumble to -40 db, wow to less than 0.15% RMS and flutter to 0.06% RMS (better than NARTB standards). Turntable speed is certified to be within ±1% of absolute.

$69.50 Audiophile Net. Write today for free illustrated literature and the name of your nearest dealer.

ELECTRO-ACOUSTIC PRODUCTS COMPANY
2135 South Bueter Road, Fort Wayne, Indiana

CERTIFIED QUALITY
Each record player is laboratory tested and is sold with a written test report coded to the serial number of that particular record player, certifying that performance is within specification limits.
HERMAN BURSTEIN

Tape is Better Than Ever!

Of the five basic audio components—the others being the phonograph, tuner, amplifier (including preamp), and speaker—the tape recorder is the baby of them all in terms of age and at the same time it is the most complex of the lot. Like the others it is a medium for reproducing sound, but unlike the others it also has the unique function of storing sound. Each of the others is either a mechanical device or an electronic device. The tape recorder is both. Thus it is complex in its functions, complex in that it requires both mechanical and electronic apparatus to serve those functions, and further complex in the coordination of the mechanical and electronic aspects.

In the approximately decade and a half that the tape recorder has been with us, a device of this complexity cannot help but have undergone changes, some under the impact of stereo and others for different reasons. On the whole, these changes have been most strongly focused on the question of format, that is, of track arrangement. This has been quite an unsettling question, involving a series of changes that tended to render tape machines obsolete unless subjected to fairly expensive modifications. Fortunately, it now appears that the issue of format has been satisfactorily decided for a substantial time to come.

Format

In the past several years, the attention of the high fidelity tapefan has probably been most strongly focused on the question of format, that is, of track arrangement. This has been quite an unsettling question, involving a series of changes that tended to render tape machines obsolete unless subjected to fairly expensive modifications. Fortunately, it now appears that the issue of format has been satisfactorily decided for a substantial time to come.

For a goodly number of years, while all was mono, format was simple and quite standard. Most home machines operated on a half-track basis, as in (A) of Fig. 1. After a tape was recorded or played in one direction, using nominally half the tape width (with a safety island to prevent crosstalk between tracks), the reels were reversed by the operator so that the other half of the tape width could be used. If one desired to operate on a full-track basis, it was usually necessary to get full-track heads on special order. The configuration with two heads in very close proximity, the in-line head, (C) of Fig. 1, made the lower track. But this was a cumbersome arrangement, and after a while the in-line head, (C) of Fig. 1, made its appearance, consisting actually of two heads within a single housing, so that the gaps were one above the other in a vertical line. The in-line head called for a decided advance in the art of head manufacture, an important part of the problem being to prevent crosstalk between what were in effect two heads in very close proximity.

Hence the quarter-track stereo (or four-track stereo as it is often erroneously called) was a natural development. Figure 2 shows the quarter-track format. The tracks numbered 1 and 3 are used when the tape is operated in one direction, and tracks 4 and 2 are used in the other direction. While quarter-track stereo solved the problems of convenience and of tape cost per minute of recording, it raised other problems. The narrower track means there is less chance for tape irregularities to average out, resulting in greater likelihood of such disturbances as dropouts (sudden, brief drops in volume). However, improvements in heads and in tape have gone a long way toward coping with these problems.

The introduction of quarter-track heads has made quarter-track mono operation possible, which means putting four instead of two mono tracks on tape and thereby doubling the amount of recording time for a given amount of tape. To take advantage of the possibility, some manufacturers have incorporated the necessary switching facilities in their tape machines so that the machine can record on one channel without erasing the second channel.

Even for new models of tape machines, it has not been easy to keep pace with changes in format. Thus today there are still some transitional problems. For example, some machines provide for stereo recording on a half-track basis, while permitting either half-track or quarter-track stereo playback. To alternate between half-track and quarter-track playback, either of two methods is used: (1) A quarter-track head is employed for both modes of operation; (2) two playback heads are employed, one quarter-track and the other half-track. Where only a quarter-track head

Fig. 2. Four track stereo tape.

Fig. 1. Head configurations for half-track and mono and two-track stereo tape.
Now Kodak brings you a new and superior Sound Recording Tape! It gives fully balanced response through the entire audio range . . . and unexcelled voice reproduction. It is the sort of tape you expect only from a company long experienced in precision coating with sensitive emulsions.

New Kodak Tape is unsurpassed for uniformity. The thickness of the oxide layer is held to a tolerance of 14 millionths of an inch! This means you will record and reproduce both highs and lows without distortion.

For years you've saved the sights you love on Kodak film. Now you can save the sounds you love on a sound recording tape of equal excellence and dependability. New Kodak Sound Recording Tape comes on a 7-inch Thread-Easy reel with a unique built-in splicer. It's at your Kodak dealer's right now. Try a roll soon.

You can depend on the name Kodak.
is employed, some machines permit this head to be shifted up or down, depending on the mode of operation, so that it will span as much of the recorded track as possible in each mode; other machines keep the head stationary to avoid the possibility of azimuth misalignment as the head is moved up or down.

Tape Speed and Frequency Response

The speeds principally in home use are hardly different today than they were al- most at the outset of the tape era. The major difference is in the performance, particularly with respect to high-frequency response, attainable at a given speed. Stated conversely, for a given level of performance the speed requirement has been lowered by 50 per cent.

Top quality home machines almost without exception used to offer a speed of 15 ips. Today some do and a number don't, with 7.5 ips being the highest speed of the latter. Taking home machines as a class, 7.5 ips has been the most popular speed for many years. However, the upper re- sponse limit used to be considered about 8000 cps at this speed, whereas today 15,000 cps or more can be reproduced at 7.5 ips.

The coupling of the 7.5-ips speed with 3.75 ips has long been popular and con- tinues to be so. Although 3.75 ips used to be regarded as a medium for anything re- sembl ing high fidelity, today it is taken fairly seriously because it permits response to about 10,000 cps, which is quite good. Inasmuch as today we can do about as well at half the speed of yesteryear, the 1.875 ips speed is coming into increasing vogue. Response to about 5000 cps can now be attained at 1.875 ips, and there are sub- stantial hopes for a still better future.

In sum, 7.5 ips is the accepted speed for high fidelity home tape recording. Virtually all prerecorded tape is made at this speed. Although there was an attempt several years ago to hull the recorded for 3.75 ips prerecorded tape, this effort seems to have fallen by the wayside.

The improvement in frequency response at a given speed is due to several factors, including playback heads with narrower gaps, improved tape oxide formulations, and better heads by tape machine manufacturers of a rather sophisticated art. The principal factor has been the development of heads with narrower gaps for playback (a narrow gap is important in recording; in fact, relatively wide gap tends to be superior).

Originally, tape playback heads (or heads for both recording and playback) had a gap about .0005-in. wide, which limited response to not much more than 7500 cps at 7.5 ips. The next development brought heads boasting gaps of about .00055-in., which made playback response to 15,000 cps possible at 7.5 ips. In the last two years or so, gaps have been reduced to the order of about .0001 in. which theoretically permits playback response to 30,000 cps at 7.5 ips and to 15,000 at 3.75 ips.

However, as depicted in Fig. 3, certain magnetic phenomena that occur in recording (demagnetization and bias erase) make it impractical to try for 30,000 cps and 15,000 cps response, respectively, at 7.5 and 3.75 ips. This doesn't mean that it is im- possible to record 15,000 cps at 3.75 ips. But it does mean that undue sacrifice in terms of distortion and signal-to-noise ratio, which are interrelated with frequency response, would be required. On the other hand, exceedingly few home machines have managed to come up to the professional specification that the machine shall operate within 0.2 per cent of exact speed. Most home tape recorders depart from exact speed by 0.5 per cent or more, some over 1 per cent. Fortunately, most of us cannot detect, and therefore are not bothered by, deviations from correct pitch unless they are over 1 per cent. However, whereas wow and flutter amounting to 0.5 per cent or more was not uncommon in early units, today a fair number of tape recorders, including some that are quite moderate in cost, fall well within the professional limit of 0.2 per cent. In fact a number of home machines have been credited with wow and flutter less than 0.1 per cent.

Motion

In contrast to their generally poor showing on the matter of signal-to-noise, many home tape machines have made amazing strides with respect to wow and flutter. Whereas wow and flutter for amounting to 0.5 per cent or more was not uncommon in early units, today a fair number of tape recorders, including some that are quite moderate in cost, fall well within the professional limit of 0.2 per cent. In fact a number of home machines have been credited with wow and flutter less than 0.1 per cent.

One area in which home tape machines have shown notably slow progress is signal-to-noise ratio. In part, this is due to the change from a half-track to a quarter-track format, resulting in a signal loss exceeding 6 db inasmuch as a quarter-track is somewhat less than half as wide as a half-track (because of the need for three safety islands instead of one). A tape recorder whose quality inherently has a signal-to-noise ratio of something like 65 to 70 db at 7.5 ips. This means that a 400-eps signal recorded at a level pro- ducing 3 per cent harmonic distortion on the tape will be about 65-70 db above the level of noise due to the tape itself. However, what we ordinarily have most to contend with is not the noise of the tape but of the tape amplifier, particularly the playback amplifier.

The very best home tape machines are able to achieve signal-to-noise ratios of about 85 db on a quarter-track basis, at 7.5 ips. True, they could also achieve 55 db years ago, but then it was on a half- track basis. In any case, there has been improvement. Such improvement is due to the development of superior play-
this small, bright light indicates a whole new world of listening pleasure

Let it guide you to the wonders of stereo music being broadcast by FM Stations throughout the country. With this all new Heathkit Stereo tuner you can enjoy AM, FM, or FM Stereo... listening unlimited (and when your FM station shifts to stereo, the light turns on; automatically alerting you). Throughout this amazing unit, both professional and hobbyist will appreciate the design, performance, durability, and styling that has made Heathkit the world leader in high fidelity electronic kits. And, as always, this superb engineering is accomplished within a price range that makes this truly remarkable instrument available to anyone really interested in fine music.

Kit AJ-41... $119.95  Assembled AJW-41....$189.95

Audio • May, 1962
fine wire rather than a ribbon of tape. But wire swelled easily and had certain technical faults (as well as existing and resultant corruption of the magnetic message). It soon gave way to tape, consisting of a cellulosic plastic or a similar arype on a supporting base. At the beginning, the base was generally of paper. But this tore too easily and with strength and time, the use of cellulose acetate was replaced by a base, eventually supplanting paper completely.

The desire for additional strength plus other characteristics, such as greater freedom from the ravages of age, resulted in the present widespread fiber—best of all, under Dupont's trade name of Mylar—as a base for many tapes. The increased strength of the base made it feasible to produce tapes two thirds or even one half as thick as these thinner tapes are respectively known as 1-mil and 1/4-mil tapes, referring to the approximate thickness of the base in thousands of an inch. Accordingly, it is possible for a 7-in. reel of tapes to hold 1800 or 2400 feet of tape instead of the customary 1200 feet. The ultimate result is that a much greater amount can be recorded on a single reel. Thus if you can record mono on a quarter-track basis at 1.875 ips, then you can still get over two hours of material on a 7-in. reel of 1/4-mil tape.

Improvements in tape have pointed in other directions as well as greater strength and longer running time. Formulations have improved toward better treble response. Magnetic oxides of greater homogeneity have been developed, eliminating dropout and allowing the recording and playback level more uniform. Lubricating materials have been incorporated in the tape to facilitate smooth passage across the heads. To reduce print-through or to increase the amount of distortion.

The Modular Approach

For high fidelity in general, the modular approach is the most often followed. That is, you can purchase a separate turntable, transport mechanism, tape electronics, and head assembly. On the other hand, based on the qualities you are looking for in each component. You don't necessarily want some manufactured in the same manner whose power amplifier you prefer.

In the beginning of the home tape recorder era, there was no such thing as the modular approach. But within a few years it began to manifest itself. Separate tape transport mechanisms, tape electronics, and heads became available. This, too, was the thought that the audiofan could assemble the recorder to which he considered best—either absolute or for his use. But it cannot be said that this trend has made great headway. The main obstacle in matching the tape electronics to the requirements of the heads. This is particularly true in recording, where the amounts of audio and bias current that should be fed to the record head are quite critical and vary from head to head. Also, it is not simple to mount heads of various kinds on a transport. There is no universal mounting plate as there is for phonograph pickups. Aside from the physical problems of how to mount heads of various sizes and shapes, there is the problem of providing two separate channels for the heads with respect to the tape. This is a more difficult problem than aligning a phonophone stylus with respect to the disc. The tape heads must be aligned in their vertical relationship. This must also be correctly positioned with respect to the axes of a head; to make this clear, we can draw an analogy to the roll, pitch, and yaw problems of a sea or air vehicle. Incorrect alignment can result in poor treble response, poor bass response, high intermodulation, cross-talk, and poor signal-to-noise ratio.

To the extent that there has been some success in the approach whereby tape machines are concerned, this is most evident in the case of the separate transport mechanisms. It has been found that for many audiofans the tape machine would fill a role analogous to the phonograph. That is, it would be used only for playing commercial prerecorded tapes and not for making recordings. Therefore one does find today several transport mechanisms that are designed to recover a head from a tape head and provide the substantial amounts of amplification and equalization required (bass boost).

Equalization

If a tape recorded on one machine (and here we are thinking mainly of a high quality machine) is to be played back with flat response on another machine, standard playback equalization is an obvious necessity. Although the phonograph industry has enjoyed the benefits of standard playback equalization for almost eight years, such good fortune has not yet visited the tape industry.

Despite the absence of official equalization standards for the tape (conspicuous only for 15 ips), has been well entrenched as the de facto standard at least for the last four years. This has become the "NAB curve", which is official only for 15 ips, has become well entrenched as the de facto standard at least for the last four years. That is, it would be used only for playing commercial prerecorded tapes and not for making recordings. Therefore one does find today several transport mechanisms that are designed to recover a head from a tape head and provide the substantial amounts of amplification and equalization required (bass boost).

Equalization

If a tape recorded on one machine (and here we are thinking mainly of a high quality machine) is to be played back with flat response on another machine, standard playback equalization is an obvious necessity. Although the phonograph industry has enjoyed the benefits of standard playback equalization for almost eight years, such good fortune has not yet visited the tape industry.

Despite the absence of official equalization standards for the tape (conspicuous only for 15 ips), has been well entrenched as the de facto standard at least for the last four years. This has become the "NAB curve", which is official only for 15 ips, has become well entrenched as the de facto standard at least for the last four years. That is, it would be used only for playing commercial prerecorded tapes and not for making recordings. Therefore one does find today several transport mechanisms that are designed to recover a head from a tape head and provide the substantial amounts of amplification and equalization required (bass boost).

Reversibility

Probably every tape recorderist at some time has been the predicament of having the tape run out while recording a program with no provision for the recording signal to be our privilege to report a vastly improved and advanced. Not so a tape. In electronics, a duplicate tape is made by playing a master tape and at the same time recording the playback signal onto another tape.

A master machine plays the master tape, and the playback signal is simultaneously fed to a number of "slave" recording machines that make the duplicates. This involves quite a large roomful of equipment. To speed up the process, both the master and slave machines operate at accelerated speeds (60 ips). Also, all tracks are recorded at once. Still the process is a laborious one compared with pressing phon records, which partly explains why prerecorded tapes are more costly than phon disks. Also, there are technical problems of maintaining consistent results from one tape duplicate to another and from batch to batch of duplicates to another.

However, progress seldom comes truly to a standstill, and one of these days it may be our privilege to report a vastly improved, less expensive method of tape duplication.
One of a smartly styled family of SLIMFORM® Speaker systems from Goodmans, the G-1 is living proof of power and performance for a price. Genuine hand rubbed, oiled walnut veneer cabinets are of ⅝" stock, acoustically lined, and decorator designed. Traditional British devotion to precision and detail was never more in evidence. All drivers incorporate curvilinear cones for rich, full sound dispersion. SLIMFORM DEKORATOR® cabinets can be used without legs, on bookshelves. Model G·1: 8" driver, 6" closed-back mid-range, 3½" high frequency tweeter, crossover network, tuned port, uniform frequency response 40-17,000 cps, 15 watts, 16 ohms, $56.50. Model G·2: 10" driver, 6" closed-back mid-range, 3½" high frequency tweeter, tuned port, crossover network, uniform frequency response 40-17,000 cps, 20 watts; $59.50. Model G·3: three 8" driver woofers, 6" closed-back mid-range, 3½" high frequency tweeter, tuned port, crossover network, uniform frequency response 40-17,000 cps, 45 watts; $79.50. G·1 and G·3 series SLIMFORM Systems measure 25" h, 17"w, 5½"d. Model G·2 measures 25"h, 17"w, 6½"d. See and hear these speaker systems at your dealer now, or write for information. ROCKBAR CORP. 650 Halstead Ave., Mamaroneck, N. Y.

The price will floor you...$56.50

Goodmans new Slimform Speaker system

See it hear it
THE FUTURE OF AUDIO

... what audio will be like in 1977

In 1955 I published a graph suggesting that logarithm of the stodgy force in home phonographs decreased as a straight-line function of time. Linear extrapolation predicted that the 2-gram range would arrive in 1962. By further linear extrapolation, I predict that home phonographs will play with 0.55-gram stylus force by 1977, and Ted Hunt's 0.1-gram prophecy will be fulfilled in ten additional years or by 1987.

By 1977 magnetic tape technology will have taken substantial strides, and because of improvements in couplings and multi-channel slow-speed recording techniques, polyhedron sound recordings (a term especially coined for this issue of Audio, denoting sound reproduction from many directions in space) will be attempted and will gain a measure of popularity. I doubt that they will displace mechanical means of recording and reproduction which have shown amazing ability to rebound when their commercial fate was endangered.

Prior to 1977 we should see some radical improvements in loudspeakers. The present method of moving external air with a heavy cone while at the same time compressing the internal air in a box is like awaiting flies with a sledge hammer. Electrostatic and similar wide area loudspeakers will find universal use. Dipoles and phase-shift loudspeakers will come into their own. Means for reproducing stereo from proximate loudspeakers will have been perfected.

The popularity of personal listening devices will increase and they will provide stereophonic reproduction by wireless.

Electronic means for controlling the acoustics of listening rooms will be widely used. No longer will the listener be at the mercy of interior decorators for his musical enjoyment.

High fidelity will be within the economic reach of everyone.

I believe that the gramophone record and pickup will not be replaced for domestic use by any form of tape or scanning system, because of the case with which you can pick up a disc, read the details on jacket or center label, and then play the movement or item you want to hear. It should also be remembered that modern records and pickups are pretty good.

I also believe that the moving-coil speaker will retain its lead at the end of the reproducing chain, due simply to physical dimensions and the laws of nature. Most people want maximum performance in minimum space, and the moving coil is the only device which will provide the movement necessary for good low-frequency output in 1 or 2 cu. ft. The flat diaphragms with possibly superior driving coverage unfortunately require 5 or 6 sq. ft. of area for full-range output.

As to the future of the hi-fi industry in general, I think this is assured by the very high quality of the individual components now available. Modern turntables, tone arms, pickups, tape recorders, amplifiers and speakers justify freedom of choice and preclude the one-piece, packaged furniture approach. An à la carte meal may cost somewhat more than a set table à l'orange, but in hi-fi it is worth it. And the speakers must be kept acoustically separate and not made into a plush padding by being mixed up with the other ingredients.

Future trends are already apparent; greater compactness made possible by transistors and more advanced applications of old principles in speaker design: some "picture frame" speakers are already available. With the continued development of electrostatics and their counterparts, the distributed-coil dynamics, perhaps speakers will become completely concealed in tomorrow's rooms. Who knows but that they will be bought by the square yard, or even by the roll, like window Shades—and used similarly? But that is only the next step. Later on it should become quite feasible to transform electrical signals to sound directly just as we are now beginning to generate electricity from heat by means of magnetohydrodynamics, thermionics, and thermoelectricity. (The Joule-Thomson principle, already in use, is in this class.)

Even this does not seem to be the ultimate. Why not excite the auditory directly? A simple operation at an early age may be carried out to install a tiny microcircuit that will permit one to hear radio and recorded signals without any loudspeakers or earphones at all. Here would be the ideal way to eliminate the plaguey imperfections of these devices. Think of hearing really perfect reproduction—and at any desired volume, without disturbing one's neighbors, or even someone close at hand! And what separation for stereo!

As to amplifiers, tuners, record players or tape units, these may well disappear from sight altogether. Stored in some concealed spot—a closet or a cellar—they will respond to spoken commands, and perhaps even to thoughts. In the latter case they should incorporate a time-delay device for people who can't make up their minds, to prevent uncontrolled oscillations.

Transistors have not yet been extensively applied in audio. All initial work with transistors suggests that basically they have every advantage over tubes for most spots in an audio system. We should not be overlooking a far greater proportion of transistor units, with improved performance over the tube types.

I also expect to see a successful velocity follower—a sort of inversion of the ribbon principle—no using some completely new principle—to give much more control over the radiation of sound waves than existing systems give. This, together with the development of satisfactory servo-feedback systems, including the radiator (or loudspeaker) in the feedback loop, will advance fidelity to a degree that will make present standards seem crude, to the more refined ears, at least.

Electronic organs for the home have already started a strong run because of the fall of electronic organs will be other electronic musical instruments that will be capable of synthesizing musical sounds of all kinds, and creating many new ones, by means that anyone can use with only a little practice. The techniques and circuitry that have been developed for them will provide the core of these developments, but a lot of new things are needed to complete the picture in the next fifteen years.

One of the fascinating parts of the audio business is that there is still great room for improvement. This improvement will follow two lines: one, the year-to-year improvement of existing devices. Phonograph pick-ups will be improved and will track at well under one gram, and the improvement of new types of tubes, methods of lowering and raising the pickup to and from the record. Loudspeakers will be improved and more and more attention will be given to the definition characteristics of music rather than to distortionless sine wave reproduction. There is still room to improve the whole electronic chain of sound reproduction.

Looking way ahead, the biggest improvement that will come will be the combination of sight and sound. No one would go to a movie today without a sound track. Likewise, for the greatest realism, all sound should be accompanied by the ple-
The superiority of new Altec Dynamic Microphones is all the more amazing when you discover their moderate price!

There are six dynamic microphones in Altec’s new professional studio series. Each sets new standards of performance and durability in its class. Each offers distinctive features of significant value to the professional user, especially since the highest price model is yours for under $100.00! Let’s take a look at some of these features:

**PROOF of Superior Performance**

Each Altec 684A Omnidirectional and 685A Cardioid Microphone comes to you with its own certified calibration curve made on a Bruel & Kjaer Graphic Recorder. In the entire professional field, this practice is unique with Altec. The one shown here is typical of the 684A. The curve you receive gives visual proof of the remarkably smooth response provided by your Altec Microphone.

**BALANCED PAIRS FOR STEREO:** For stereo work, any pair of 684A or 685A Microphones is perfectly matched in performance characteristics. The calibration curves offer rapid means of assuring yourself of this balance.

**DESIGNED FOR RIGOROUS PROFESSIONAL USAGE:** The exclusive sintered bronze filter positively bars all foreign matter. These Altec Microphones may be used safely in any situation the professional engineer finds himself not only in a protected studio, but anywhere—a metals grinding mill if need be. Only Altec offers this absolute protection against the gradual degradation of quality common in ordinary microphones that can’t prevent dust, moisture, and minute ferrous particles from restricting diaphragm movement. Also featured are diaphragms of indestructible polyester that cannot be damaged by blasts, shock, impact—designed specifically for rigorous usage in any professional applications.

**EXCLUSIVE ALTEC MICROPHONE EXCHANGE POLICY:** After expiration of normal full year guarantee, you may exchange an inoperative microphone for a comparable new unit at a fraction of original cost. This Altec policy is unique in the industry, offered to better serve microphone users.

---

**Altec 684A OMNIDIRECTIONAL MICROPHONE**
- Frequency Response: 35 to 20,000 cycles
- Output Impedance: 300 ohms
- Output Level: -25 dBm/10 dynes/cm
- Frequency: 40 to 16,000 cycles
- Output: 30 dB
- Price: $81.00 net

**Altec 685A CARDIOID MICROPHONE**
- Frequency Response: 35 to 20,000 cycles
- Output Impedance: 300 ohms
- Output Level: -25 dBm/10 dynes/cm
- Frequency: 40 to 16,000 cycles
- Output: 30 dB
- Price: $125.00 net

**Altec 686A LAVALIER MICROPHONE**
- Frequency Response: 70 to 20,000 cycles
- Output Impedance: 200 ohms
- Output Level: -25 dBm/10 dynes/cm
- Frequency: 40 to 16,000 cycles
- Output: 30 dB
- Price: $54.00 net

---

(Continued on page 78)
New Products

- High Fidelity Recorder. A high-fidelity wire recorder which incorporates the principles developed in recent years by the Armour Research Foundation of the Illinois Institute of Technology was announced recently by Magnecord, Inc. Designed for professional users, the Magnecorder Model SD-1 has a frequency response rated flat within 2 db from 50 to 12,000 cps with a signal-to-noise ratio of well over 45 db.

- New Dynamic Microphone. Through the use of the new Acoustalloy diaphragm developed by E-V engineers, the Electro-Voice Model 630 dynamic microphone now provides high fidelity pick-up and reproduction of voice and music, suitable for a great variety of applications. Frequency response is substantially flat, 40 to 9000 cps. Output level is 5% below 1 volt/dyne/cm², open circuit. Voltage developed by normal speech (10 dynes/cm²) is .0324 volt. The new Acoustalloy diaphragm withstands high humidity, extremes of temperature, corrosive effects of salt air, and severe mechanical shocks. This makes the Model 630 Microphone especially rugged for indoor and outdoor use. Alnico V and Armco magnetic iron are also utilized in a non-welded magnetic circuit. (May, 1947)

- Rek-O-Kut Console. A beautiful new console (transcription or recording cabinet) is being shown by the Rek-O-Kut Company, New York City. This cabinet is sturdily built, being made specifically to mount the various Rek-O-Kut recording and transcription turntables. It has a drop-front door and self-contained pockets for holding approximately 100 sixteen-inch records. The console is finished in a metallic two-tone grey—dimensions 22” high by 36” wide and 25” deep. Outlets and terminal blocks for motor line and pickup are mounted on the motor board. Four screw jacks are provided for leveling the console. The entire unit can be sold separately or in conjunction with any of the regular Rek-O-Kut transcription or recording turntables. (July, 1947)

- Shure Wire Recording Heads. These new recording heads have the following features:
  1. Versatility of playback and recording circuits.
  2. Variety of impedances for individual needs.

- Fisher Amplifier. The new Fisher Dynamic Noise Suppresser-Wide Range Amplifier features 26-watt output with less than 1 per cent distortion. Response is rated uniform within 1 db from 20 to 20,000 cps. The phone circuit is compensated for use with the new magnetic pickups made by G. E. and Pickering. Equipped with bass and treble controls, as well as means for regulating band width, and noise suppression.

  This amplifier uses the following tubes: 2-12A7T, 1-6C4, 3-434A, 1-6AL4, 1-6AQ5, 2-6ES. Licensed under Hermos Hoener Scott patents pending. (June, 1948)

- Pickering Cartridge Reproducer. Bringing the advantages of the Pickering Pickup to the user of conventional record players and changers, the Pickering Cartridge is now available at most distributors. The moving system which generates the electrical signal is identical in construction to the Pickering Pickup which has been so successful in the highest quality reproduction of phonograph records and lateral transcriptions.

The recording medium for this custom-produced unit is stainless steel wire .004 inch in diameter. However, the unit utilizes a capstan drive system to drive this wire across the heads at four feet per second. This design assists greatly in the elimination of wow and flutter and produces constant wire speed.

Using standard size spools, the Magnecorder is capable of recording and playing back continuously for a half hour. The unit performs a wide variety of services in the average radio station, is capable of synchronization for motion picture production uses, and is suitable for laboratory use. (May, 1947)

- Scott Amplifier. The dynamic-band-pass principle reaches new peak of performance in the Type 210-A laboratory amplifier. This unit, supplied with a matched variable reluctance pickup cartridge, provides a complete phonograph system except for turntable or record changer and loudspeaker. The amplifier provides 20 watts output with less than 2 per cent distortion, and below 3 watts, the distortion is under .5 per cent. The output transformer is arranged to match speaker impedances between 2 and 500 ohms.

- New Voice Model 630 dynamic microphone now provides high fidelity pick-up and reproduction of voice and music, suitable for a great variety of applications. Frequency response is substantially flat, 40 to 9000 cps. Output level is 5% below 1 volt/dyne/cm², open circuit. Voltage developed by normal speech (10 dynes/cm²) is .0324 volt. The new Acoustalloy diaphragm withstands high humidity, extremes of temperature, corrosive effects of salt air, and severe mechanical shocks. This makes the Model 630 Microphone especially rugged for indoor and outdoor use. Alnico V and Armco magnetic iron are also utilized in a non-welded magnetic circuit. (May, 1947)
Hermon Scott faced a basic choice... bring out his new LK-48 amplifier kit at $124.95 or make it to sell for $30 less like many other amplifier kits. All his engineering department had to do was make a few compromises.

The LK-48 is rated at 48 watts. By using a smaller power supply, ordinary output transformers, and pushing the output tubes to their limits, the amplifier might still produce 48 watts at 1000 cycles where many amplifier kits are rated. But measured at 20 cycles, where Scott engineers feel power is really important, output would be down considerably. No compromise was made. The LK-48 actually produces 28 watts per channel at 20 cycles, and delivers full power throughout the audio range.

Many kits use a one color instruction book. Hermon Scott decided to continue to use full color to insure factory-built performance, even at the hands of a novice.

Important Scott engineering extras like the all-aluminum chassis, DC operated preamp heaters and unique hum-null balancing could have been eliminated. Hum would have been audibly higher and distortion at levels normal to many kits, but Hermon Scott felt that the kit builder was entitled to the same performance he has come to expect from Scott factory-wired units.

Yes... Hermon Scott could have made the LK-48 to sell for $30 less... but it would have meant compromising life-long standards. This is something he would never do. You can choose any Scott kit with complete confidence -- the LK-48, the LK-72 80 watt complete stereo amplifier, the LK-150 130 watt stereo power amplifier, the LC-21 professional preamplifier, the LT-110 multiplex tuner, LT-10 FM tuner or the LM-35 multiplex adapter. These superb kits have all the features and performance you've come to expect from the world's leader in audio engineering.

H.H. SCOTT
H. H. SCOTT INC., 111 Powdernill Rd., Maynard, Mass. 01754

Please rush me your new full-color brochure telling about Scott's full line of superb stereo kits.

Name: ..................................................
Address: .............................................
City: ................................................. State: ........................

Export: Marhan Exporting Corp., 458 Broadway, N.Y.C.
Prices slightly higher West of Rockies.
A unique mounting, the keystone clip, attaches to any standard pickup arm, and the cartridge slides firmly onto the clip, permitting longitudinal adjustment for minimum tracking error. The cartridge has a sapphire stylus with a tip radius of 0.003 in., considered ideal for reproduction of shellac records. The output, at approximately 60 mv, is designed to be fed to the grid of a tube.

A simple circuit provides a 12-db/octave rolloff above 4000 cps, when desired, for reduction of surface noise. (July, 1947)

- Electronic Volt-Ohmmeter. Eico announces another addition to their line of test equipment the Model 221 Vacuum Tube Voltmeter.

A completely new and modern approach in designing vacuum tube voltmeters makes this an exceptionally high quality utility instrument at an unusually low price. Its amazing performance sets standards of accuracy, linearity, and stability, with a coverage of wide ranges and applications hitherto not usually available in this type of instrument.

1. Completely electronic on all functions and ranges.
2. Electronic a.c. range is more linear and accurate than was ever possible with a copper oxide rectifier. More accurate measurements can now be made over a wider frequency range.
3. The meter can not be burned out. This automatic overload protection is only possible because of its all-electronic circuit.
4. Special type electronic bridge circuit practically eliminates all zero drift short warm up period.
5. Accuracy is 2 per cent on all ranges.
6. Each instrument is individually calibrated.
7. Twenty-six (26) megohm input resistance.
8. Electronic a.c. and d.c. ranges 0-5, 10, 100, 500, 1,000 volts.
9. Electronic ohmmeter measures from 0.2 ohms to 1,000 megohms on five ranges.

10. Wide range db scale.
11. Stable on all ranges, due to carefully designed compensating circuit.
12. Complete instructions included with every instrument.
13. Large 4½" meter with 2 per cent accuracy.
14. One single linear scale for both a.c. and d.c. measurements. (June, 1948)

(Continued on page 95)

THE BEYER DT-48 DYNAMIC HEADPHONES...

are not and never will be mass produced. In fact, only 450 sets will be available for U.S.A. customers this year. Can you imagine the cost of hand machining every component part, including the outer housing, from solid metal? Only in this way can the dimensional stability which is required for such precision, be assured. Inevitably, the DT-48 had to be the most expensive headphone on the market today; but the thrill of hearing fidelity and low distortion, which no speaker system at any price can match, justifies the investment many times over. Readyly connects to any power amplifier output with accessories supplied. Guaranteed for 6 months.

SPECIFICATIONS:
- FREQUENCY RANGE: 16-18,000 cps.
- SENSITIVITY: 114 db-SPL/mW at 400 cps, usable with 600 ohm line levels. (TR-48 required as accessory)
- DISTORTION: Unmeasurable above 100 cycles and less than 0.3% RMS below 100 cycles.

DT-48 OWNERS! New cushions available as replacement for $3.90

For more information write for Bulletin #5a and include name of your dealer.

GOHAM AUDIO CORPORATION
2 WEST 46 ST., NEW YORK 36, N.Y. (212) CO 5-4111

why $79.50?

PIONEERS

(from page 60)

with the Minnesota firm to develop a thin tape coated with a ferro-magnetic powder.

The company, with its long history of producing adhesives, soon developed a binder. In 1946, 3M, deciding that the key to the future of magnetic recording would be a superior oxide, set out to do just that.

That decision brought Wetzel, then head of the physics section of the company's central research division, into the program.

By 1947, Wetzel's research group had developed a black oxide product on a paper backing. Later that year, 3M produced the first plastic-backed tape. The extremely smooth acetate surface was a decided improvement over the comparatively rough paper surfaces used previously.

Continued experiments led to the development of a superior magnetic material—a red iron oxide. It made possible high fidelity recording at slow
tape speeds, providing good frequency response and more uniform signal output. It also was easily erasable.

With this tape, 3M contacted machine manufacturers and interested them in designing low-cost, slow-speed recorders. The company went into full production and started marketing the tape—the now-familiar No. 111 “Scotch” brand.

However, as frequently happens in research, there was an ironic twist to the discovery. When Wetzel and co-worker, H. K. Smith, moved to patent oxide, they learned that an application had already been filed for patenting the same product by Marvin Camras of Armour Research Foundation. Subsequently, the Foundation licensed 3M to produce the oxide.

The revolution was completed in the spring of 1948 when ABC radio used the new tape to pioneer delayed broadcasting during daylight savings time periods. That launched the professional use of tape by the entire radio, recording, and motion picture industries.

Dr. Wetzel is a member of the American Association for the Advancement of Science, the American Physical Society, and the Society of Exploration Geophysicists. He is a Fellow of the SMPTE and an Honorary Member of the Audio Engineering Society.

Thomas A. White

Tom White joined Jensen as Sales Manager in 1928. He was instrumental in the thirties in introducing the first line of component hi-fi speakers, including woofers, tweeters, and multiway systems that were widely available through distributors. He traveled extensively in the period prior to World War II and established foreign distributors and manufacturing licensees.

Specialization in the engineering and manufacturing of the more complex types of loudspeakers brought Jensen the assignment of major supplier of speakers to the armed forces during World War II. Mr. White became Vice President of Jensen in 1940, President and General Manager in 1945. When Jensen became a division of The Muter Company in 1950, he was named a Vice President of that company. Under his leadership Jensen has become, in sales, the world’s largest producer of loudspeakers.

Tom White has been active in the administrative and committee work of Electronic Industries Association, serving as a member of its board of directors from 1943 to 1949.

Grommes announces a completely new concept in mechanical and electronic engineering excellence to provide Multiplex Stereo with performance and “presence” never before accomplished heretofore. Owners of Grommes FM Tuners will be pleased to know that Grommes Tuners are adaptable for receiving FM Multiplex Stereo broadcasts through the use of Grommes low cost Multiplex adapters. Your Grommes equipment is never obsolete as Grommes engineers always plan ahead for things to come. Remember, when you buy Grommes, you buy the finest in FM-Stereo, regardless of price. Ask your high fidelity dealer to demonstrate Grommes. You will hear music with the new Grommes extra-“presence”.

Grommes/MULTIPLEX

Grommes announces a completely new concept in mechanical and electronic engineering excellence to provide Multiplex Stereo with performance and “presence” never before accomplished heretofore. Owners of Grommes FM Tuners will be pleased to know that Grommes Tuners are adaptable for receiving FM Multiplex Stereo broadcasts through the use of Grommes low cost Multiplex adapters. Your Grommes equipment is never obsolete as Grommes engineers always plan ahead for things to come. Remember, when you buy Grommes, you buy the finest in FM-Stereo, regardless of price. Ask your high fidelity dealer to demonstrate Grommes. You will hear music with the new Grommes extra-“presence”.

Grommes

M1 MULTIPLEX
(FM-STERO) ADAPTER

Converts any high quality FM tuner to receive FM stereo programs. Connects to multiplex output of tuner and to auxiliary inputs of stereo amplifier. NO CONTROLS TO CRITICALLY ADJUST. Has full frequency response, separation and noise filter switch for fringe areas. Low heat silicon power supply.

Send coupon today for complete details on Grommes equipment.

Name........................................................................
Street......................................................................
City.............................................................Zone ... State.

Grommes

DIVISION OF PRECISION ELECTRONICS, INC.
9101 King Avenue, Franklin Park, Illinois, Dept. TI

www.americanradiohistory.com
1. FIFTEEN YEARS AGO...

(Records—fifteen years ago? I don't have any left. Well, hardly any. After a long search through my shelves I did find the following, which I noted for its review in the July 1947 Tape? Who'd heard of tape in 1947. Had you?)


How those old shellac discs take me back! This was one of the earliest batch of Decca ffr records—still not officially named London—that the ole Delta decided to release for review in July, just two months after we began operations at Tape! Who'd heard of tape in 1947. Had you?

The recording, to this day, fifteen years later, sounds typically ffr. Cut a 1942 ffr recording on 78, press it in shellac, and you'd have a record that would last through the newly uncovered highs.

The recording, to this day, fifteen years later, sounds typically ffr. Cut a 1942 ffr recording on 78, press it in shellac, and you'd have a record that would last through the newly uncovered highs.

For music like this, I'll take the distortion gladly, even today in 1962.


No special alphabet label for Columbia in 1952. Then, as now, they were just plain Columbia Records. But this one is really quite remarkable, after ten years. The sound was not quite of a special order, but I remember. It is modern than almost any other I've tried, including the Mercury "Living Presence." The record plays best on the old Columbia setting (NAB), at RCA Best, high rolls off somewhat on the tone control.

Dvorak: Nature, Life and Love; Notturno. (Four works for orchestra.) Vienna State Opera Orch., Swoboda. Concert Hall CHS 1141.

In mid-1962, this one makes me shed a tear for old Concert Hall—I miss the label, I must say. In 1952 I was enthusiastic about the "f" on this one—see what I meant, though technically I was wrong; for there is a large amount of steady distortion in the sound, very likely the result of fancy "jiggering" for exaggerated presence. Concert Hall was fond of that sort of thing.

What is wrong with this disc is that the excellent music, very nicely played, is a really striking sense of presence and liveliness. No doubt about it—this company knew how to take sound, with a more-than-concert-hall illusion. It's a paradox that some of this illusion is, indeed, due to probably deliberate distortion of the mid-range and highs. Given a bit of ear-tolerance, as we all had in 1922, these effects are musically acceptable.

Typically, the record will not play with really adequate tonal balance on any equalization position I have available. Too much distortion. (Boost the highs and it really screams.) I will love it.

Strauss: Oboe Concerto (1945); Violin Concerto (1881). Ertel, Barrie; Symph. Radio Berlin, Rother. Urania URL 7032.

This is one of the musical prizes in my record collection, two unusual Strauss works, a battery of well in half-century apart, in excellent performances. Records like this are timeless from a musical viewpoint, 1952 or no.

And other than the recorded sound is, of course, our point of view, remarkably well mixed, with a good liveliness and presence for almost, the soloists close but well integrated into the orchestral sound. This is a very close, as I remember, and it has a well-remembered tonal quality, too, a species of slight sore throat, so to speak. Continuous grating distortion, no worse in the loud parts than the soft, which in itself is unusual.

The explanation, I suspect, is that this is probably one of those early German Magneto-phon tapes that originated during the forties, namely, 1942 and 1943, and were used in the U.S., in part as the spoils of war. The distortion is not in the disc cutting but, I strongly suspect, in the master tape itself. All the early Urania had it, few of them bad enough to spoil good listening.

For music like this, I'll take the distortion gladly, even today in 1962.

AmericanRadioHistory.Com

Edward Tattnall Canby

RECORD REVUE

1962
JUST RELEASED

On AUDIO FIDELITY RECORDS

WITH STEREOPHONIC CURTAIN OF SOUND* RECORDING TECHNIQUE!

Recognized for years by discriminating listeners for true stereophonic reproduction and the highest standard in high fidelity!

*REG. U.S. PAT. OFF.

NEW! FREE! 
Complete catalog—fully illustrated with complete selection listings for each record—mono and stereo. Complete stereo tape listing. Send for your copy now!

May 1962

www.americanradiohistory.com
There is no finer performance

QUALITY
For the audio perfectionist, the FM-Multiplex Dyna­

ator has set new standards for usable sensitivity

under the most difficult conditions, with lower distor­
tion at all signal strengths — faster limiting, simple­

er and more accurate tuning, better capture ratio, im­

proved interference rejection. No overload­
ing, outstanding AM and multipath rejection, supple­
tive selectivity, and lower hum and noise. For the kit
builder, assembly and alignment are completed in

just 6 hours, and performance specs are met in

the first time.

FM-3 Multiplex integrator $29.95 kit.

FM-4 $79.95 kit, $119.95 assembled and tested.

ECONOMY

Easily the finest value in the high fidelity field, this

"no distortion" preamp has won acclaim for im­

provable performance, at just about the lowest price

ever for a stereo preamplifier. Full control flexibil­

ity in a simple, modern arrangement makes it easy to

build and a pleasure for the non-technical music

lover to use. You'll revel in its near-perfect freedom

from hum, noise, and distortion. Just $99.95 buys

the most important improvement in your music system.

PA-6-2 $59.95 kit, $99.95 assembled and tested.

DEPENDABILITY
Not more than two years old, but we've never had to

make a single change in the Stereo 70 amplifier.

Patented Dynaco output transformers and circuitry,

and the superior reliability of the finest etched circuit

construction assure continued superiority of perfor­

mance. In the words of Hans Honk Laboratories

(December 1955 issue of High Fidelity Magazine)

"This amplifier's components are operated more con­

sequently than those in any other commercial ampli­

fier we have tested... Its power and distortion ratings

are completely incomparable. Its listening quality is

noted not only for its Sarcastic..."

Stereo $90.95 kit, $129.95 assembled and tested.

QUOD ERAT DEMONSTRANDUM: which was to be proved

write for

DYNACO, INC.


Cable Address: Dynaco, Philadelphia.

AUDIO • MAY, 1962

...continued from page 14

The two solists are close and very loud, as was

the then universal mixing style — each, violin and
cello, as big as the whole orchestral accompaniment.
Thank goodness, we've moved today towards a more natural balance of solo

versus orchestra, mainly thanks to stereo and

the need for spatial placement of the soloist in

the orchestral picture.

RCA's discs evidently didn't yet have vari­

able groove spacing — too need for it here—

and the grooving is relatively shallow as com­

pared to later RCA cuts. There is throughout a

faintly noticeable trace of metallic edginess

and the grooving is relatively shallow as com­

parative literature...
Cutter Heads

After listening awhile to 1952 quality variation (the records I chose were released more or less at that time, and uniquely almost represented the actual work of the last several years, culminating in the brand-new "initial" recordings of then remote date)—I began to pigeonhole the recording cutter as maybe a major factor, in what I heard. Now this I cannot confirm; but (you recording engineers)—wishing it in this period that really factory wide-range microgroove cutters, a "second generation" of them after the semi-improved first ones, began to come into use! Wann't the new quality splurge based first of all and 'way down deep on improved cutting heads, with the use of hot-stylus cutting (havent checked on the date of that innovation?)

I'm reasoning thinly because, as I reconstruct it, the other elements in the long chain were much less crucial—subject to more gradual improvement. Yes, there was rumble from cutting tables. There was hum, often present. There was, especially, a lot of pitch variation, most of it easily traceable to the tape recorders, both recording and playback. There was electronic distortion—all along the way, of course, and most objectionably in the still-new tape recording method—varying from practically none, at best, to a great deal, at worst. But none of these factors, as I see it, was as concrete and specific in the 1952 sound as the "sound" of the actual cutting heads themselves.

Remember that until 1948 or 1949 the 78-rpm shellac disc was perfectly OK for public acceptance with no more than, perhaps, 4000 cpm at the top and a great deal of assumed all-over distortion, mostly masked in the high-end, plus a large amount of severe loud-passage unpleasantness, more or less taken for granted what with the hopelessly inadequate inner 78 grooves and the incompliant, grossly crude tracking of the average home reproducing pickup. It wasn't until LP that these things began to be unpleasantly noticeable on much home equipment. It took a huge effort to remove them—after LP was launched, for the most part. The cutter was the key.

So, in many 1952 records you will find a continuous distortion (as per above, the beginning of this piece) that I feel strongly inclined to pin upon the disc cutter head, even if it did add its own to distortions already present in earlier stages. You will also notice an even more tell-tale cutter distortion, which I know from my memory that we accepted then as a matter of course—the extra-distortion of louder passages. We still have the problem faintly today. But in 1952 you will find a great number of discs which purr like so many hi-fi kittens in the softer passages, and as soon as volume goes upwards break into a most unpleasant shilliness and, as I used to put it, "busyness." Cutting-head trouble, I'll wager.

The trouble was, then, that our home pickups reflected precisely similar characteristics. They were tough, reliable, relatively wide-range in their response and relatively flat, too, given a nice quiet passage. But in louder passages they buzzed all over the place to beat the band. They did it quite impartially, of course. As we heard the 1952 discs, a clean load passage buzzed just as mercilessly as one that in fact was "dirty" on the record itself.

So—I'm giving a tall guess that a major factor in the introduction of each of the new "initial" record labels around 1952 was the introduction, behind the scenes, of new cutting head equipment and associated circuitry. You can spot it, I maintain, by the very sound of those new records. They were suddenly cleaner, smoother, wider in tonal range; but they were particularly cleaner in the loud passages.

...And Tape

Yes, there were tape problems, of course. Especially among smaller outfits and very especially among those who had to work in Europe, with the overlastingly unstable European voltages! But even American tape suffered, as I immediately recognized when I surveyed my batch of 1952 discs. You can't pin down the precise all-electronic distortions that come from a master (or copy) tape as distinguished from those originating elsewhere. Not most, anyway. But a few typical tape distortions do show up immediately and amusingly—of 1952. Pitch distortion was the biggest one of all. It's astonishing how much variation in basic pitch was tolerated by us listeners, from movement to movement. Try the beginning of a record, then, maybe, the opening of the second movement. A quarter-tone flat, or even more! Tape trouble. Some of it labored over at the tape playback. But a lot wasn't, even on reputable labels. Much worse, of course, were the momentary pitch inaccuracies. They vary from those brief sags, five or ten seconds long, which now startle me into thinking my turntable must be out of order, through the dreadful cases of inexcusable wow that

an astounding new sound... an incredible new cartridge

SHURE M33

Stereo Dynetic®

An extraordinary achievement in superior re-creation:

RESPONSE: 20 to 20,000 (conservatively). Singularly clean and smooth. Goes right through the top limits of audibility without a hint of "break-up" prevalent in most other stereo cartridges.

COLORATION: virtually non-existent. Imparts no false sound to the music. It is transparent, clear, hum-free (special Mu-metal shielding rejects electrically induced hum). Peak-free.

COMPLIANCE: over 20X10^-6 cm/dyne! Tracks as low as 1 gram... virtually eliminates record and stylus wear. Separation over 22.5 db. at 1000 cps.

THE STYLUS: Choice of .0005" or .0007" diamond tips. Exceptionally rugged. Special plastic grip makes stylus changing easy as plugging in an electric cord.

PRICES: M33-5 (with .0005" diamond) or M33-7 (with .0007" diamond). Tracks at 1 to 3 grams... $36.50 net. Model M77 (for tracking at 4 to 7 grams) only $27.50.

SHURE Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois

AUDIO • MAY, 1962
The Future of Audio

(from page 69)

The Future of Audio

The French have a saying that the more things change, the more they remain the same. In the last fifteen years the audio field has done nothing radically new; it has done the same thing radically better. There has been immense attention paid to

---

Peter C. Goldmark

---

The big improvements which may come will most likely be in the program sources and in the transducers. At present, records, home tape playback, and FM radio transmission are second-rate, not because of limited technology, but because of failure to process for the high quality market.

Transducers such as photo pickups and speakers will be improved to the point where they match the capabilities of the electronic parts of the audio chain.

The advent of transistors and newer tube types will not make for better sound, but merely for more economical and more portable equipment.

I will make one drastic prediction for audio for the next fifteen years. In this period, audio will move with video; and home reproduction will encompass both periods, audio will merge with video; and home reproduction will encompass both periods.

---

David Hafer

---

One may be allowed to guess that there will always be a 3-way competition between the "package" radio-phonograph, the compact "component" audio, and the truly high quality audio which components can offer.

As Howard Souther put it, the quality audio components started with pioneers putting professional quality speakers of large size and stark weird-looking horns in living rooms; "never allow form and appearance to interfere with performance and function."

My opinion is that there will be a growth of such quality systems which means those which are functionally correct where decor and size are made to conform to function.

No doubt improvements will be made within the limits of the laws of physics, but if I may be permitted to sound a warning, beware the "major breakthrough" which should have been rock-smooth, and are in today's recording. Tape was bad, variably, and good, while the so-called "superior" category, RCA LP's (you can forget the 45) in the late 1100's, the early 1700's. (The numbers appear over interchanging categories. RCA numbers aren't trustworthy as to dates.) Listen to Westministers in the low 5100's, Capitol after F-8184, the early FDS Mercury in the 60000 series, beginning the Olympian "Living Presence." Vanguard in the very low 400's—they were just beginning. Vantage around LP 7100 through roughly the 7700's, edging into 1953. Uranias—if you have any—in the 5000 and 7000 series. Alchemies in the 3000's and from the 70's to the early 100's.

London grr is plain nuts—I never could figure their number system. But some

London in the 400-500 series belong in this period; also the low numbers, 28, 40, and so forth. All those since withdrawn and some recut later according to RIAA, as with the Westminster 5000's and many others.

There weren't any Angels, of course. The Angel parent company in England, the lordly EMI, if I remember correctly, was still busy making 78's in 1955, and not a word about LP. We missed an EMI big-shot, used to visit over here every year and we invariably quizzed him on the subject of EMI LP's—to come. Not a word out of him. Not, even when one year, maybe about that time, he arrived like a cat with a mouse, a batch of anonymous, white-label test LP's under his arm. We asked him whether this meant EMI was at last going into LP. No comment.

THE FUTURE OF AUDIO
In my opinion, our magnetic recorders will use some kind of cartridge or magazine and the tape will not be handled directly. Magnetic recorders will be developed similar to a Juke Box. This equipment will contain an extended amount of selections; any selection could be played back by pressing a few knobs or the machine will play all selections in sequence.

There will be very efficient recorder-playback units in cars. Driver could dictate or listen to music or lectures of his own choice.

There will be pocket units developed of extremely small size and of high fidelity caliber. The person attending concerts or meetings could record anything he would like to preserve.

It is obvious that the use of audio recording will expand tremendously in all language schools.

Alexander M. Poniatoff

Having lived right in the midst of high fidelity's many remarkable developments in the past 15 years—I find it particularly pleasant to sit back and "imagine"—on things of coming 15 years hence.

For one thing, I believe automation will play a significant part in high fidelity. All types of sensors and other magnetic devices will be used to make the home music system fairly self-sufficient ... leaving the music lover the sole task of finding a comfortable chair to sit back in ... and listen!

Components will shrink in size ... wireless audio controls will fit into the base of a lamp, a bookend or the palm of one's hand and will include provision for controlling the radio tuner. It will actually transmit supersonic signals to a sensor receiving unit. Power amplifiers and radio tuner chassis will be located in space normally wasted ... there will be virtually no heat because transistors and rechargeable battery-packs will permit cool low-voltage operation ... hum will no longer be a problem. Moreover, the battery-packs will automatically recharge themselves at a predetermined voltage level. Phonograph turntables will be reduced to a few inches in diameter... their motor will be replaced by a wafer-thin magnetic circuit rotating at the precise speed of 2 rpm. Microfiber-stylus grooves in a 4-in. record will provide hours of music containing as many as 24 selections on a single side ... each would be selected by switching to a different frequency unscrambler by means of magnetic sensors.

Phonograph cartridges will achieve a degree of sensitivity so great, they will respond to microwave vibrations riding through a record groove as if in orbit. They will contain micro-miniature high-frequency transmitters enabling the need for interconnecting cables. As a matter of fact, a complete record playing system will be so compact, it could be moved and operated remotely from any part of the house without a plug or wire in sight. Tape recorders will be made more compact—about the size of a package of pre-recorded tape as we know it today. And, it will run at one speed for hours, with the best fidelity. A built-in super-sensitive microphone would record a second program simultaneously ... using a multiplexer channel so the existing recording would not be erased.

Speakers will be installed all through the house. They will be electrostatic—requiring little more space than that occupied by a wall receptacle today. Private listening will be quite popular, using tiny ear receivers that require no wires and volume level would be automatically controlled by the noise level in the room.

The quality of high-fidelity music reproduction will improve immeasurably... problems we have today with noise and distortion—insignificant as they may be—will not exist 15 years from now. New circuitry and electronic developments will operate in a new dimension free of dependancy upon local utilities. One thing is sure ... high fidelity will be stereo ... but I won't venture any guess as to the number of channels we will have.

Walter O. Stanton

I would feel a lot safer talking about 25 year from now instead of 15. Anyway, I think that sound reproducing systems will be smaller, easier to install, simpler to operate, less expensive in spite of historical inflation, and higher in quality in the sense that the sound will be closer to the live instruments.

My guess is that speakers will be spherical in shape, small, without enclosures.

I think that an increasing part of the energy put into high-fidelity components today will be used to improve hearing aids.

Ed Pitcher

The signal-to-noise ratio of tape recorders will be so greatly improved during the next 15 years that the tape machine, when used in connection with cartridge tapes, will become the commercial rival of discs.

I predict a 20-3b improvement in the signal-to-noise ratio, which will make available machines with an 80-db ratio.

This achievement will eliminate all equipment noise; making black tape noiseless when played on the proper equipment.

Now what do you think?

F. W. Welsel

EXCLUSIVE!

Starting new features available only in Audio Dynamics components provide almost unbelievable performance.

Forget about record wear. Play records at peak performance even if they are warped. Hear the entire audible range without distortion. How? With these technically superior features available only in Audio Dynamics components:

First, the ADC-1 and ADC-2 cartridges that give you:

Lowest stylus mass: a mere half-milli-gram eliminates high frequency distortion and helps to provide excellent channel separation.

Unusually high compliance: at least 20 µm per 100 µs and more, reduces record wear and distortion negligible.

Lowest tracking force: less than 1 gram, renders record wear and distortion negligible.

Next, The Pritchard Tone Arm:

Very low inertia with perfect balance: gives highly stable tracking at low stylus pressure.

Only 1/4" rear overhang: makes installation easy in the tightest cabinet space.

The side thrust compensator: first of its kind in an American model, helps to maintain even groove wall pressure.

Single ball bearing mountings: Minimize lateral-vertical friction.

An accurately machined and treated walnut tone arm: suppresses extraneous resonances.

New type wire guide: Tone arm wire can no longer exert drag on the moving system. It moves as a unit on its own axis!

Plug-in head: easily accommodates all quality cartridges.

And now the Pritchard Pickup System. By combining the ADC-1 cartridge and the Pritchard tone arm, a remarkable system is produced. This system tracks at 3/4 gram! Surely with these exclusives, it is worth your while to hear superb Audio Dynamics components at your dealers' today!

Audio Dynamics CORPORATION
1677 Cody Avenue
Ridgewood 27, New York

AUDIO - MAY, 1962
79
STEREO

Terry Gibbs: The Exciting Terry Gibbs Big Band

Verve VSTC 264 (4-track UST stereo tape)

Fifteen years ago big bands were coasting along on momentum gained during the swing era, but most leaders thought postwar prosperity would create a great new demand for such services. So many explanations are given as to why this failed to happen that the only mystery remaining is the continued existence of the band. A visiting Count Basie and Duke Ellington could maintain small groups and do as well or better financially, with the gigs selling out on the strength of the name. Bill Duke would climb to much higher tax brackets at the head of popular dance orchestras. Even more remarkable is the changed attitude of established studio musicians, many of whom a few years ago would go on the road than established studio musicians, many of whom a few years ago would have thought going on the road a step down.

Among the reasons offered for a quartet. Instead, Gibbs organized a re-creation of that restless urge by devoting time and momentum gained during the swing era, but most leaders thought postwar prosperity would create a great new demand for such services. So many explanations are given as to why this failed to happen that the only mystery remaining is the continued existence of the band. A visiting Count Basie and Duke Ellington could maintain small groups and do as well or better financially, with the gigs selling out on the strength of the name. Bill Duke would climb to much higher tax brackets at the head of popular dance orchestras. Even more remarkable is the changed attitude of established studio musicians, many of whom a few years ago would have thought going on the road a step down.

Among the reasons offered for a quartet. Instead, Gibbs organized a re-creation of that restless urge by devoting time and effort to rehearsing bands. Gibbs remained undaunted, his resolve unshaken, and the band's style thoroughly up-to-date.

He was a member of Woody Herman's "Four Brothers" band for a year, then formed a band of his own just as the going got rough. Most of the past decade was spent leading small groups and in studio work. His present ideas of what the orchestra should resemble are those of a bygone era, and he plays vibes with all of Lionel Hampton's exuberance. These are stonemaid vigorously, and the orchestra sometimes sounds like the rhythm section of a swing band.

The Summit is becoming a popular West Coast spot for band recording because of several advantages not always found in studios. Apart from the benefits of audience enthusiasm and the respect of Local 802 members, gained a host of admirers and drew the executive attention which sent her to Hollywood. Pressings often come back with added echo though the jukebox trade receives an echoed sound. Pressings often come back with added echo though the jukebox trade receives an echoed sound. It was the case a few years ago. Others take care of that restless urge by devoting time and effort to rehearsing bands. Gibbs remained undaunted, his resolve unshaken, and the band's style thoroughly up-to-date.

"When big bands are recorded in the studio," states Heider, "most producers insist that this method gives the most natural sound and fastest results in a club. Actually, it requires closer attention to mike placement and a keen ear at the controls. I used this 'head-on' approach in the studio when recording Roberta Alexander's band playing "Kansas City Suite." With bands like those of Basie and Gibbs, the expert dynamic shading of the call-and-response patterns between sections makes it impossible to go wrong."

A jazz fan of long standing, Heider also became interested in audio as a hobby while practicing on occasion. This was after the two evolutions in a professional career, he held his own rehearsals by recording informal practice sessions of local units and anything else that came along. When Putnam sold Universal Recording and moved from Chicago to open United three years ago, Heider was ready and willing to leave the law in other bands. He created Putnam for putting the finishing touches on his engineering education, and a good share of the jazz assignments came his way because he knows Putnam. Among his forthcoming efforts are one-hour programs featuring Les Baxter and Stan Kenton for a new syndicated radio show, and on Art Blakey's Remote at a Los Angeles club.

This album title may alarm some loyal Art Blakey fans, as they know from experience what happens when the group starts playing in a new setting. Art Blakey was one of the first leaders to fit on the spot in something less cold and determined promotion can still strike it rich for the youth who has no more to offer than slight ability and an obvious oneness. This was just an attempt to make a record that was just an attempt to make a record that was just an attempt to make a record. Blakey was just as determined to do it right, and the whole enterprise was designed to keep staff musicians busy. Besides fulfilling the show, the new vocalist earned appreciative applause from the audience, who had been waiting very patiently.

With Jack Marshall acting as escort, Miss Shore returns to the scene of her early triumph, and made a jingle for a soap under Martha's Patch. Currently appearing at movie theaters in a new version of "The Great Gatsby," she is too busy to learn about the latest fashion in country music. Hopeful that her next album was recorded in Hollywood, the typical Nashville sound is present throughout. From the perspective of a great beat drummer, the twenty-year-old import from Sweden fits into this down home environment like one of Birgit Persson's cousins, even to the extent of a gospel-charge but Blakey, in a way that was just an attempt to make a record. Blakey was just as determined to do it right, and the whole enterprise was designed to keep staff musicians busy. Besides fulfilling the show, the new vocalist earned appreciative applause from the audience, who had been waiting very patiently.

With Jack Marshall acting as escort, Miss Shore returns to the scene of her early triumph, and made a jingle for a soap under Martha's Patch. Currently appearing at movie theaters in a new version of "The Great Gatsby," she is too busy to learn about the latest fashion in country music. Hopeful that her next album was recorded in Hollywood, the typical Nashville sound is present throughout. From the perspective of a great beat drummer, the twenty-year-old import from Sweden fits into this down home environment like one of Birgit Persson's cousins, even to the extent of a gospel-charge but Blakey, in a way that was just an attempt to make a record. Blakey was just as determined to do it right, and the whole enterprise was designed to keep staff musicians busy. Besides fulfilling the show, the new vocalist earned appreciative applause from the audience, who had been waiting very patiently.

With Jack Marshall acting as escort, Miss Shore returns to the scene of her early triumph, and made a jingle for a soap under Martha's Patch. Currently appearing at movie theaters in a new version of "The Great Gatsby," she is too busy to learn about the latest fashion in country music. Hopeful that her next album was recorded in Hollywood, the typical Nashville sound is present throughout. From the perspective of a great beat drummer, the twenty-year-old import from Sweden fits into this down home environment like one of Birgit Persson's cousins, even to the extent of a gospel-charge but Blakey, in a way that was just an attempt to make a record. Blakey was just as determined to do it right, and the whole enterprise was designed to keep staff musicians busy. Besides fulfilling the show, the new vocalist earned appreciative applause from the audience, who had been waiting very patiently.

With Jack Marshall acting as escort, Miss Shore returns to the scene of her early triumph, and made a jingle for a soap under Martha's Patch. Currently appearing at movie theaters in a new version of "The Great Gatsby," she is too busy to learn about the latest fashion in country music. Hopeful that her next album was recorded in Hollywood, the typical Nashville sound is present throughout. From the perspective of a great beat drummer, the twenty-year-old import from Sweden fits into this down home environment like one of Birgit Persson's cousins, even to the extent of a gospel-charge but Blakey, in a way that was just an attempt to make a record. Blakey was just as determined to do it right, and the whole enterprise was designed to keep staff musicians busy. Besides fulfilling the show, the new vocalist earned appreciative applause from the audience, who had been waiting very patiently.
FOR A LIMITED TIME ONLY!

SAVE $1.50

ON THESE TWO VALUABLE REFERENCE BOOKS

BUY BOTH FOR ONLY $4.95 postpaid

The 5th AUDIO ANTHOLOGY reg. $3.50
The 4th AUDIO ANTHOLOGY reg. $2.95
Both $6.45 reg.

Here's what the 5th AUDIO ANTHOLOGY contains —

- THE BIGGEST AND BEST VOLUME EVER!
- MORE THAN 50 ARTICLES COVERING STEREO RECORDING AND REPRODUCTION; STEREO MULTIPLEX; MEASUREMENTS; STEREO HIGH FIDELITY TECHNOLOGY; CONSTRUCTION AND THEORY; etc.
- 144 PAGES WITH COMPLETE ARTICLES BY WORLD FAMOUS AUTHORITIES IN THE AUDIO AND STEREO HIGH FIDELITY FIELD.
- ATTRACTIVELY PRINTED AND BOUND FOR EVERLASTING USE. AN IMPORTANT STEREO HIGH FIDELITY REFERENCE BOOK.

If you've missed the 4th AUDIO ANTHOLOGY . . . here is a wonderful opportunity to buy it at more than 50% off the regular price when you buy the 5th.

This offer good only while the supply of the 4th lasts, and may be withdrawn without notice.

Use handy order form below. We pay postage anywhere in the U.S. add 50¢ for Foreign orders.

RADIO MAGAZINES INC., Dept. 452
P.O. Box 629
Mineola, New York

☐ Enclosed is my remittance for $4.95. Send me both, the 4th and 5th AUDIO ANTHOLOGY Postpaid.
☐ Enclosed is my remittance for $3.50. Send me only the 5th AUDIO ANTHOLOGY Postpaid.

NAME ........................................... ADDRESS ...........................................
CITY .............................. ZONE ......... STATE ............................

www.americanradiohistory.com AmericanRadioHistory.Com
TRANSMITORS
(from page 24)
derived from loads in the collector circuit of the p-n-p driver transistors. Emitter degeneration is employed to insure a high degree of linearity in the operation of the output circuit.
A single-ended signal representative of the double-ended output waveform across the load is obtained from a novel one-transistor difference amplifier. Appropriately attenuated signals from each side of the load are used to drive the base and emitter of the difference amplifier.
The use of a large resistor in the emitter of the difference amplifier insures a very high degree of difference amplifier balance and stability regardless of possible changes in transistor characteristics. The single-ended and amplified output appears across the difference amplifier emitter resistors. It is injected in a conventional manner to an earlier low-level stage in the amplifier, thus completing the feedback loop. The elimination of output and interstage transformers allows a large amount of stable feedback which produces a linear damped output without ringing, and greatly extends the low-frequency capabilities of the unit. The use of diffused-base power transistors with common emitter cutoff frequencies greater than one megacycle assures adequate high-frequency response.
A high degree of difference amplifier balance and stability regardless of possible changes in transistor characteristics. The single-ended signal representative of the double-ended output waveform across the load is obtained from a novel one-transistor difference amplifier. Appropriately attenuated signals from each side of the load are used to drive the base and emitter of the difference amplifier.
The use of a large resistor in the emitter of the difference amplifier insures a very high degree of difference amplifier balance and stability regardless of possible changes in transistor characteristics. The single-ended and amplified output appears across the difference amplifier emitter resistors. It is injected in a conventional manner to an earlier low-level stage in the amplifier, thus completing the feedback loop. The elimination of output and interstage transformers allows a large amount of stable feedback which produces a linear damped output without ringing, and greatly extends the low-frequency capabilities of the unit. The use of diffused-base power transistors with common emitter cutoff frequencies greater than one megacycle assures adequate high-frequency response.
This description does not bring out one important feature of the full bridge which helps to make the full bridge a very attractive circuit. So long as power transistors 1 and 3 are driven hard enough the system can be completely controlled by transistors 2 and 4. The split off to the n-p-n driver is not too critical, therefore, and the close balancing is only needed in the p-n-p side.
The only European amplifier so far located is that designed for use with the French Orthophase loudspeaker: this is a giant assembly of large and robust ribbon microphones. To drive this speaker to 100 w, an amplifier using a half-bridge with two parallel transistors in each arm has been designed (see Fig. 8). The driver is transformer coupled to the output stage, which has +24- and -24-v. supplies. The transistors used are the OC36 low-frequency transistors, though the ASZ1S is being adopted. The OC36 has a common-emitter cutoff frequency down around 3500 cps and something of the order of 40 db of negative feedback is taken round from the live end of the speaker to the base of the high-frequency power transistor driver.
The driver itself is fed through a transformer from the preamplifier. Negative feedback is also used with two anti-resonant circuits to deal with speaker peaks on 300 and 3100 cps. Although this amplifier will give 100 w at 50-2000 cps, the available power drops away to 25 w at 10,000 cps and 10 w at 20,000 cps (though the ASZ1S gives better results). The response is flat to ±0.1 db from 50-20,000 cps and up to 2000 cps the distortion could not be measured. The really interesting feature here is the use of low-frequency transistors and good orthodox design to allow plenty of feedback to be used: the pay-off, the very low cost of the transistors.
Can we see any common style developing yet? I think not. Certainly the output transformer is out and my guess is that the half-bridge circuits will win in the end: but what does my guess really mean? Only that I would start off by using half-bridge circuits myself. But there is something more needed somewhere before we really hit the answer on output stages. Let us go back to the other end of the amplifier.
Front end design is, in some ways, more uniform. The phonograph input is designed to accept some 3-5 millivolts and a two-stage preamplifier is used to raise the level to the level at the next selection point. Equalization for the RIAA characteristic is provided by an RC feedback network connected between the second collector and the first emitter.
This low-level input may also be used for tape, in which case the equalizer network is switched by the input selection switch. Some, but not all, amplifiers allow an in-

FREE HOME DEMONSTRATION!

Enjoy a free demonstration of the remarkable Electro-Voice Model 643 in the comfort of your own living room. No cost or obligation.
No fuss or muss, no coupons to fill out, and no salesman will call! All you do is flick a switch!

Turn on your TV set during the next presidential news conference. Any channel. Look closely and you may see what appears to be a "bazooka" on stage next to each TV camera covering the reporters. This is the E-V Model 643 dynamic Cardiline microphone, the most directional broadcast microphone on the market!
The 643's are up to 50 feet away from the reporters, yet the sound is clear and natural in quality . . . you can hear as well at home and sometimes better than the President himself! Compare this unobtrusive pickup with the conventional hand-held microphones or "cornfields" of microphones used in the past. A dramatic demonstration that the 643 reaches farther than any other broadcast microphone available!
And there are plenty of other demonstrations. At football games and parades, 643's pick up marching bands with recording fidelity up to two city blocks away! In TV and film studies and on remotes the 643 delivers clean dialogue despite wind and noise that would spoil the "takes" from an ordinary microphone.
The E-V Model 643 is another example of the many positive contributions by Electro-Voice to professional sound pickup techniques. If your sound problems can be solved by a 7-foot microphone that "reaches" farther than any other, arrange now for a studio demonstration of the unique new 643. Ask your E-V professional microphone distributor for details today!
Fig. 8. Circuit of Orthophase OR6T120 Amplifier.

put to be connected after the preamplifier. Tone control follows the preamplifier and appears to be standardized as a single-stage transistor amplifier with the response control in the feedback path. Volume and balancing may be before or after this stage. From this point on we are in the main amplifier.

(Continued on page 85)
1947. A year before the coming of the long-playing record, "High fidelity" was not yet a layman's concept. It was the record business, not the "recording industry." Heavy pickups, cactus stylus, and plain record sleeves were still in use. Bizarras and kaddies roamed through the hushed confines of the late Gramophone Shop in New York. To most of us, discounting was something that went on in the "wholesale" district. A trio of giants dominated the record scene: R.C.A. Victor, Columbia, and Decca; while the "odd labels" restricted their activities to jazz, folk music, and esoterica.

The postwar boom in record sales had reached a high point. Record dealers stacked bestselling albums as if they would never be able to order them again. Hard put to supply the demand, manufacturers were forced to reduce everyone's orders so as to spread their product over a larger number of outlets. Certain leading shops, therefore, deliberately over-ordered such albums as the Tchaikovsky First Concerto (Horevitz/Tozsani), and also the Grieg Piano Concerto (Rubinstein/Ormann), by the hundreds so as to be sure of obtaining quantities close to their real demand. (As the supply caught up with the demand, this little trick occasionally backfired.)

Less Per Minute

Today the consumer pays less per minute of music than he did 15 years ago, records being one of the few commodities which did not spiral upward in price during these inflationary years. A recording of Tchaikovsky's Pathétique Symphony, for example, cost some seven dollars on 78's; today's LP versions are priced anywhere from two to five dollars less (in monophonic form).

The lowest-priced imported record, however, was higher than the prime 12-inch domestic disc: Americans paid $1.50 for the 10-inch, plump label H.M.V. record which contained some five minutes of program material. The larger discs sold for $2.50 apiece; and certain choice items, such as James Joyce's reading of his Anna Livia Plurabelle, went for $12.50.

It should be stated at once that the avid record collector was not daunted by these prices. Just as many big-city dwellers now spend more on rent than they should, the middle-income concertgoer of 1947 behaved like a Florentine nobleman of the Renaissance when he came to acquiring the imports dear to his heart. And dear they were—Debussy's Pelléas et Mélisande, for instance, extended to no fewer than twenty top-priced French H.M.V. discs, whose total cost was $50. Arias by Puccini were being snapped up at $4.25 per disc, which came to more than fifty cents per minute on the average operatic LP.

Popular Imports

The popularity of imported discs among a small but devoted segment of the record-buying public led to some extreme practices. With their abundant supply of shells from India, British manufacturers were able to sell exceptionally quiet surfaces. This, combined with their high standards of craftsmanship, made many of our U.S.-made records sound as if they had been pressed on sandpaper. As a result, quality-conscious collectors sometimes would place specialty imported-record dealers for English pressings of domestic recordings—at two and a half times the price. Even the most sullen H.M.V. pressing, however, could not eliminate shellac hiss entirely.

Around this time, R.C.A. Victor and Columbia brought forth their own release of Vinylite pressings, the former in rich, red translucency, and the latter in a more conservative black. The public was less than enthralled. Many of these "silent" surfaces were hardly quiet at all (the bugs have still not been eradicated in today's LP Vinylite grooves), and, to the owner of a low-fidelity table radio-phonograph, the advantage of the new discs over the shellac was not abundantly clear. Besides, they were more expensive.

Apart from their technical superiority in terms of the actual disc, the British were making caustic remarks in sound reproduction. In 1946 the first "packaged" English Decca frr albums made their appearance in the U.S. Never before had such extraordinarily realistic orchestral sounds been engraved on a disc. More than any other event, the release of this album brought "high fidelity" to the American public during the 78 era.

It Was Easier Then

The record reviewer's lot in 1947 was a lot happier than it is today. A full-time critic could then cover a major portion of the recording output, including imports. Today he is lucky if he can keep up with his stock pile of reprints. Playback systems, too, were less of a problem simply because there were very few component manufacturers. Record producers (artist and repertoire directors) also had a much easier time of it. Since everything had to be recorded in segments of from two to four-and-a-half minutes, a record side was cut over and over again until everyone was satisfied. A commercial element has since been injected into the record-making procedure: the tape editor. Seldom does a performer know how to record their half of the tape-to-disc transfer room without the cosmetic nicks of the editor's blade.

The picture on the album cover was still a relatively new development. Compared to many of today's LP jackets, the 78 cover was as tame as the art work for a book of
fairy tales. There was Brahms at twilight strolling through a Disney-like forest, Mozart in cameo-souvenir likeness gazing serenely into space, and the picture of the cut diamond to tell us that Beethoven's Violin Concerto is a gem of a work. Few of the illustrated covers were to match the elegance and good taste of R.C.A. Victor's embossed, gold-lettered albums with buckram spines, which were introduced just before the lifting of the Petrillo ban in 1944.

Discounts

In 1947 the idea of buying records at a discount was almost as outlandish as asking the newsstand vendor for a reduction in the price of your daily paper. The time was soon to come when discount merchandising and "perpetual" sales were to become the order of the day in most cities.

One could still be sufficiently avant-garde in 1947 to have sampled or heard in its entirety each important new release. In minutes of music, the record companies still produced only a tiny fraction of what they (and all the LP-spawned firms) bring forth today. New recordings were awaited eagerly, and, for weeks and even months following the releases, homes and record shops would reverberate with discussions on the merits and weaknesses of the latest crop of Columbias, R.C.A.'s, or imports. In today's crowded market, too many releases pass virtually unnoticed, lost in the unremitting torrent of new material pouring from dozens of sources.

Audio shows were years away in 1947. The average classical record buyer was still blissfully unaware of equalization, cartridge design, crossover networks, and tone-arm resonance. He just put a record on his turntable, ran his finger across the "needle" point to see if the rig was on, lowered the arm (or set the changer mechanism), and relaxed. Occasionally he might adjust the treble or bass controls, but, compared to his later-day counterpart, he was nothing less than a sonic primitive. But that was before Astor came along.

TRANSISTORS

(from page 83)

One feature which the Fig. 7 circuit includes, which is not in the others, is a smoothing and regulating transistor in the power supply. This is a series transistor with its base fixed by a zener diode and the rather rough d.c. applied to the collector. At the emitter the voltage should be smooth and constant, just what is needed for the more sensitive points in the circuit. The French designer uses an inductance for smoothing the supply to the low-level stages but otherwise it's just RC, RC.

This, then, is the round-up to date. British manufacturers say no one wants transistor power amplifiers, that no one is offering them, that Mr. — will call back. Thus will be the hands of the printers, or the readers, by the time the London Audio Fair comes along. If there is anything you should know about, you will be told. After all, there is a classical tag which you can look up for yourselves in the original—from the East always something new and strange.
Have You Heard The PLAYMATES

Matching Stereo Hi-Fi Speaker System

The Playmate is beautifully styled in Walnut Finished Veneer. Finished on all four sides permitting vertical or horizontal use and specially dimensioned for Book Shelf, Highboy or Lowboy Floor installation. It is ideal for use as a single unit by itself, perfect in pairs for stereo or as an addition to your present system. Truly superb performance, compact, in tasteful design to compliment in quiet elegance.

**Equipped with 2-6" Speakers and 1-4" Tweeter!**

The Playmate is specially designed with matched Woofers, Midrange and Tweeter Speakers plus suitable Crossover. Full base response to below 40 c.p.s. with clean and clear brilliance to 18,000 c.p.s. Capacity 25 watts—Impedance 8-16 ohms.

*Write for literature on Playmates and complete Line of High Fidelity Speaker Systems*

**Net Each**

**$39.95**

---

**SEARCHING?**

If you are tracking down a technical article — in a current, or even not-so-current, issue of a magazine — do it the easiest way with LECTRODEX, the original radio-electronic magazine index. In only minutes you can locate the subject you want, and it costs you only pennies per issue of LECTRODEX.

For more than a decade, librarians, engineers, teachers, students, researchers, hobbyists and technicians in the radio-TV-electronic fields have referred to LECTRODEX for information about articles from amplifiers to Zener diodes.

LECTRODEX covers more than twenty-five publications in the radio and electronics fields and is published bi-monthly as a cumulative index throughout the year with the 6th or last issue as an Annual which may be kept as a permanent record of all radio-electronics and related articles published that year.

**LECTRODEX**

Available by subscription only:

One (1) Year $1.00 — Two (2) Years $1.50

---

**LECTRODEX**

P.O. Box 629
Minota, New York

Subscription Rates: U.S. & Possessions $3.00 for six issues; $5.50 for twelve issues; all other countries $3.50 for six issues.

Please enter my subscription for LECTRODEX. I enclose $ ....

for a ... issue subscription.

Name

Address

City .............. Zone ........ State ............

---

**LIGHT LISTENING**

(from page 10)

did during low-level passages in classical music.

I never realized how good the highs on those old two-track stereo reels were until the ultra-narrow-gap heads demanded by four-track tapes made their appearance. In going back over my stack of two-track tapes with a tape head designed for four-track, I was tickled to discover that the superior frequency response of the ultra-narrow gap performed another function. Earlier tapes I had once considered shrill in the range between 7000 and 10,000 c.p.s. now sounded much smoother when the new response above 10,000 had a chance to balance out the stuff beneath it. To take one example at random: the first tape I headed for when I got a machine with the new heads was the Columbia Original Cast two-track of “West Side Story” issued in 1958. On the old machine (same make as the new one) I had to roll off highs wherever I could on the preamp but the darn tape still couldn’t be made to sound as flat as the mono record version. Even when I switched tape machines a few years later without disturbing the rest of the system, the “West Side Story” tape came under control without a knob being touched.

In the matter of bass response, two-track stereo tapes are still in a class by themselves. Only these tapes can bring into full play my four-wide-exursion woofers. It may be pointless to talk about tape releases no longer in print but the best foundation speakers I have in my collection are two-track stereo tapes such as the “Band of the Coldstream Guards” under the direction of Major Douglas A. Pope (RCA Victor BPS-118) and Dick Schory’s New Percussion Ensemble in “Music for Bang, Baarrow and Harp” recorded on the home grounds of the Chicago Symphony Orchestra on RCA Victor tape CPS-255. Near the top end, these tapes subject you to, by a thousand cycles or so, of the very best stereo discs we have available today but the bass end is a powerhouse you’ll probably never encounter on a disc in the foreseeable future.

The psychological attributes of the human ear being what they are, today’s four-track tapes sound adequate when you let some time go by after you’ve been exposed to a good two-track. In the case of a poor and distorted two-track, you may be able to enjoy a four-track after an hour or so has elapsed.

The history of the stereo disc is still fresh enough in the minds of most sound fans to require little comment today. I did my share of groaning and head shaking when the first stereo discs came out. Within a year, however, I was willing to concede that most of the faults of the early discs were traceable to the first stereo pickups. By the autumn of 1958, the components industry had on the market a stereo pickup that still turns in a creditable performance today in the company of the very latest high-compliance cartridges.

Anyone using such a pickup in a good system during the early days of stereo discs would have noticed, as I did, that the best-sounding releases came from a source in Snakville, Wisconsin that had achieved fame in the mid-Fifties with a micro-groove 78-rpm mono disc. The Audiophile
Once the recording industry had a workable two-channel disc, stereo's first mass audience came into being. Significant help in spreading the use of stereo came from such familiar show albums as "My Fair Lady," recorded in London in February of 1959 with essentially the same Broadway cast featured in the earlier seller mono version. Sold shows such as "Oklahoma!" and "The King and I" had their compelling moods of their casts and the cast stereo disc recordings taken from the sound tracks of the movie versions. Listeners unimpressed by a concert hall ambiance that may have been unfamiliar to them, responded to stereo's recreation of a performance on a stage or a movie sound track.

A survey of the last decade should make at least glancing reference to the 3.75-ips stereo tape cartridge that was championed by E. D. Nunn a year ago. I've never been able to muster sufficient enthusiasm for that tape system to discuss it in print or over the air. When I attended the first public showing of the tape cartridge, the same recording was played for the press in two versions... tape cartridge at 3.75 and stereo cartridge. Somewhat to my surprise, I preferred the sound of the disc even though the latter was recorded on a mono photophone with an early ceramic pickup.

Another recent development in the record industry is the attempt to revive the 45-rpm microgroove disc. The basic advantages of a speed higher than 33⅓ rpm have been known for some time. At 45 rpm, stylus acceleration in the stereo cutter and playback pickup is not quite the problem it is at the slower speed. A stereo pickup on a 45-rpm record has no record in which to track from a given compaction angle as it does at 33⅓ rpm. The importers of the Schoeps condenser microphone have brought out a fan of 10-inch 45's for stereo records to the accompaniment of groans of anguish from other labels and manufacturers of single-speed turntables. I secured two test pressings of the new label, called appropriately enough Quarante-Cinq... the French word for forty-five. I grant that my reaction to the discs may be influenced by the fact that I have a three-speed table. The sound I get is a distinct departure from the conventional LP. Unlike some subjective reactions in this field, this one is easy to describe. The sound of these 45's has an open quality that the old 7-inch 45-ips mono discs never exhibited. Quarante-Cinq record #45002 called "Bravo! Toro" features music of the bull ring and contains 16 ½ minutes of music on one side that is split up into five bands. A companion release (Quarante-Cinq 45001, "Music of Chabrier") delivers 19 minutes of music on one side. This is a clear indication that the variable-groove method was used in making the master. The recording level on "Bravo! Toro" is no higher than that found on well-made current 33⅓ rpm stereo discs. If the masters of these 45's were made with a conventional stereo cutter, it is interesting to speculate on the results that might be attained if the cutters now in use were to be modified for operation at the higher speed. As things stand now, the transients of the castanets are a particularly convincing demonstration of...
New!

B-W

INSTRUMENTS
for AUDIO
MEASUREMENTS

MODEL 410 DISTORTION METER
• Measures audio distortion, noise level and AC voltages • Also a versatile vacuum tube voltmeter.
• Distortion levels as low as 0.1% can be measured on fundamental frequencies from 20 to 20,000 cps.
• Distortion measurements can be made on signal levels of .1 volt to 30 volts rms.
• The vacuum tube voltmeter provides an accuracy of ±5% over a frequency range from 20 cps to 200 KC.
• For noise and db measurements, the instrument is calibrated to 1 db steps from 6 db to 15 db, the built-in attenuator provides additional ranges from -60 db to +50 db in 10 db steps.

MODEL 210 AUDIO OSCILLATOR
• Provides a sine wave signal from 10 cps to 100 kc. Output level within ±1 db when working into 600 ohms (reference 5 kc). Power output, variable to above 150 mw. Hum and noise, ±10 db.

These instruments are supplied with many B.C. station installations for FCC Proof-of-Performance tests.

BARKER & WILLIAMSON, Inc.
Radio Communication Equipment Since 1922
BRISTOL, PENNSYLVANIA • Stillwell 8-6681

The First Book of its Kind—No Other Like It!
SOUND in the THEATRE
by Harold Burris-Meyer and Vincent Mallory

Nothing like SOUND in the THEATRE has ever been published. It is the first book to set forth in authoritative detail what you can do with sound by electronic control, and how to do it whenever the source (singer, musician, speaker, etc.) and the audience are present together. The book develops the requirements for electronic sound control from the necessities of the performance, the characteristics of the audience (hearing and psychoacoustics), and the way sound is modified by environment, hall, and scenery. Sound sources are considered for their susceptibility of control and need for it, and the many techniques for applying electronic sound control are described and illustrated in thirty-two specific problems. From these problems are derived systems and equipment specifications. Complete procedures are given for: Planning, assembling, and testing sound control installations—Articulating sound control with other elements of production—Rehearsals and performances—Operation and maintenance—of sound control equipment.

THE AUTHORS

During the past thirty years, the authors have developed the techniques of sound control in opera, open-air amphitheatres, theatres on Broadway, theatres on-the-road and off-broadway, in concert halls and night clubs, in Hollywood and in the laboratory. Some of their techniques are used in broadcast and recording as well as in performances where an audience is present. From their laboratory have come notably successful applications of sound control to psychological warfare and psychological screening.

RADIO MAGAZINES, INC.
Dept. AG-1
Post Office Box 629
Mineola, New York

I am enclosing my remittance for $1.00
Send my copy of SOUND in the THEATRE postpaid.

(No C.O.D., all books sent postpaid in U.S.A. and possessions, Canada, and Mexico. Add 50¢ for Foreign orders.)

Name _______________________________ __
OIJ------------
Zone ________________________________ 
Add 60c for Foreign orders.)

Add 60c for Foreign orders.

THE ART
(from page 6)

The forward strides taken in these latest 45's. Whatever new developments come out of the recording industry in the years ahead, I feel reasonably confident that the standards of Audio will be as quick to support the genuine as they have been to reject the make-believe.

Those Low Levels

In the early days, preamps for low-output pickups (or microphones) needed all kinds of massive shielding, tubes gradually built up to somewhere between 20 and 30 db, without too much trouble. Distortion, measured into a resistance (dummy) load, was really low and engineers were happy. Sometime listeners weren't, because they were faced with the necessity of using a loudspeaker load, to provide watts they could listen to. Low distortion in a resistance is one thing; getting the same quality into a loudspeaker voice coil proved to be another.

Multi-loop feedback served two purposes. First, the more-feedback-the-better group could now add the figures in the various loops and get a total close to 100. As the customer had always rated things by per cent, maybe he thought db was a misprint!

The more sensible thing that came out of multi-loop was enabling feedback to achieve each of its advantages—reducing distortion, controlling output impedance (damping), stabilizing gain, and so on—indipendently and at the same time.

Even today, however, we hear db figures quoted for the "amount" of feedback, which is strictly not a good practice. If the amount of feedback is exactly a certain figure, and fixed at that figure, then it is not reducing distortion, modifying impedance, stabilizing gain, and so forth, because none of these things need doing (wonderful hope!) and therefore feedback isn't needed in the first place.

In other words, the very fact that these things do need caring for, and that properly designed feedback does it, means the feedback is not constant, and therefore quotation of a simple db figure is meaningless.

Feedback was also applied to "front ends" or preamplifiers. Theory showed feedback reduced noise, hum, microphone, and anything else that might be a problem. Unfortunately such theory was mere algebra and did not include the complex functions, or take into account level changes. When these were taken into account, it was found that feedback does not help low-level input stages as much as expected—in fact, it could make matters worse.

The more sensible thing that came out of multi-loop was enabling feedback to achieve each of its advantages—reducing distortion, controlling output impedance (damping), stabilizing gain, and so on—indipendently and at the same time.

Even today, however, we hear db figures quoted for the "amount" of feedback, which is strictly not a good practice. If the amount of feedback is exactly a certain figure, and fixed at that figure, then it is not reducing distortion, modifying impedance, stabilizing gain, and so forth, because none of these things need doing (wonderful hope!) and therefore feedback isn't needed in the first place.

In other words, the very fact that these things do need caring for, and that properly designed feedback does it, means the feedback is not constant, and therefore quotation of a simple db figure is meaningless.

Feedback was also applied to "front ends" or preamplifiers. Theory showed feedback reduced noise, hum, microphone, and anything else that might be a problem. Unfortunately such theory was mere algebra and did not include the complex functions, or take into account level changes. When these were taken into account, it was found that feedback does not help low-level input stages as much as expected—in fact, it could make matters worse.

Those Low Levels

In the early days, preamps for low-output pickups (or microphones) needed all kinds of massive shielding, tubes
mounted in super-super-anti-microphonic mounts, and d.c. heater supply, highly smoothed, with chokes and capacitors as big as a house, not to mention cost. Those days have gone.

But still we have some trouble with tubes for low levels. We've lost count how many numbers have been issued for improved versions of the 12AX7, only to be withdrawn later. Many preamp makers still find the European ECC83 a better equivalent.

In the front-end, or preamp department, the matter of "how many knobs?" has absorbed a lot of mental energy—and resulted in some unique approaches. A question still asked is, "Why be so particular about having the correct equalization, if you're going to put in all kinds of tone control, so that by the time you're through you don't know what you've got anyway?". We've been thinking of printing a form letter to answer that one.

Boost and Cut

More seriously, there is the question whether separate bass and treble controls are an advantage to the average user. On this score, there are still people who tell us, quite seriously, that nobody can tell the difference (a) between bass cut and treble boost and (b) between bass boost and treble cut. If that were true, it's quite obvious only one control is needed—the volume control! As most of us can distinguish bass from treble, or low from high frequency, these controls must definitely do serve functions that any decent ear can distinguish.

However, there is something to be said for a single control that does both at the same time: from bass boost and treble cut, through something nearly level, to bass cut and treble boost. Such a control would be much easier for the novice to set to the satisfaction of an experienced listener.

For the real tone-control fiddler, most of the time there have been available some super-duper tone controls, that adjust the response at any number of points. At first sight this seems a wonderful idea. It's only in practice that the limitations show. For each filter to produce really noticeable effect, the cutoff rates need to be sharp, resulting in poor transient handling, even in the "flat" position—don't argue, please, it's a fact. If simple, low-rate cutoffs are used, it takes extremely careful listening to find out whether each knob really does something different from its neighbors on either side—so why have so many?

The Latest Greatest

The latest thing in audio is FM-stereo. This writer's view has always been that radio, including FM, is radio, and hence out of audio's bailiwick. Several audio

In All the World Never a Hi-Fi Kit Value Like This

**FM STEREO BY knight-kit®**

**STEREO FM**

**MULTIPLEX KS-10A ADAPTER KIT**

**$19.95 ONLY NO MONEY DOWN**

*enjoy beautiful Stereo FM reception at unbelievably low cost... Now you can have the pleasure of an easy kit-building experience. Now you can add the tonal beauty and realism of Stereo FM broadcasts to your present music system. The savings simply can't be duplicated. The quality can't be matched for anywhere near the price. Order the KS-10A Knight-Kit Multiplex adapter today—no money down (just check coupon). An unbeatable value at only..... $19.95*

**PROOF OF SUPERIOR VALUE:**

- Self-powered—Installs out of sight
- Separation control for precise stereo adjustment (23 db separation)
- Input sensitivity 0.2 volts
- Frequency response 50-15,000 cps, ±1 db
- Noise filter (switchable) for use in weak signal areas
- Top-performing circuit using 2 dual and 1 triple-purpose tubes
- Power supply transformer-operated; uses selenium rectifier
- Pi-filter network for ripple-free B+ voltage—hum is practically inaudible
- Precision coils
- AC on-off switch
- Three 36" connecting cables included
- Simply plugs into your tuner's Multiplex output and your amplifier's tuner inputs.
- With all connecting cables, tubes, parts, and famous Knight-Kit step-by-step instructions. 3½" x 8½" x 4". For 110-125 v. 60 cycle AC. 4 lbs.

**typical of the value and quality of over 100 other KNIGHT-KITS**

**KNIGHT ELECTRONICS DIVISION ALLIED RADIO**

**Satisfaction guaranteed or your money back**

**ALLIED RADIO**

100 N. Western Ave., Chicago 80, III.

□ Ship me ... KS-10A Knight-Kit Adapter(s) 83YX656AF

□ Ship on Allied's Credit Fund Plan—no money down

□ $ . . . . . . . . enclosed (check) (money order)

Name

Address

City Zone State

www.americanradiohistory.com
Here's the first 12" tone arm to match the wealth of features made available on the now famous Thorens "TD" turntables!

It's the new THORENS BTD-12S Tone Arm. And it's tops because Thorens engineers have thought of everything: Lowest possible inertia. Precision ball bearings on all axes. A precision cueing device to set stylus on record or lift it off without damaging grooves.

And adjustments! No other arm has so many! Lateral Balancing: An adjustable damped counterweight balances cartridges weighing 5 to 19 grams. Stylus Force: Spring-applied — making it unnecessary to level turntable — is adjustable by a calibrated knob (0 to 8 grams). Adjustable Stylus Overhang: You can easily set this critical distance for the arms optimum tracking error 0.5"/inch max.) for every cartridge with slide in plug-in shell (7/16" range). And Height: There's an adjustment for that (1%" range) plus a unique, Thorens designed pivot that keeps stylus in a vertical plane for every setting! Get full details on the unique Thorens BTD-12S tone arm today! See your franchised Thorens dealer, or write us direct.

THORENS BTD-12S TONE ARM, supplied on mounting board for Thorens models TD-124 and TD-121 turntables. Can be used on any turntable.

Guaranteed for One Full Year. $50.00 net

THORENS DIVISION
ELPA MARKETING INDUSTRIES, Inc.
New Hyde Park, N. Y.
familiar with handling discs. As mentioned previously, Wyte, Frayne, and Davis of Westrex, prodded by Capitol Records' Ed Ueke and RCA Victor's Bill Miltenberg, worked on modernizing Blumlein's early vertical-lateral cutters concept. EMI in England also got busy doing the same.

Dr. Dutton (EMI) writes:

"The major recording companies in Europe met on November 28, 1957 at Zurich to pool our information and discuss the relative merits of the 45/45 vs. the hill-dale/lateral system. It was decided unanimously to recommend the 45/45 system and I then attended a meeting of the technical committee of the RIAA at Indianapolis at which I reported the recommendations of the European meeting and as you know these appeared to be in full agreement with those of the RIAA."

By April, 1958, nine companies in the U. S. were making and releasing 45/45 stereo discs. The 1958 NAMM Show in July was a clean sweep for stereo records. Stereo tapes and tape machines in general were to have their worst year. The 7½-ips two-track stereo tapes at $12.00 to $16.00 each were no match for stereo discs of the same tunes at $4.95 and $5.95. The two- and three-track master tape at the record company didn't care whether it made stereo tapes or stereo discs. But the people making tape machines cared a great deal! Something had to be done. A good stereo tape (sometimes hard to find) lasted for countless playings, and didn't have pops and ticks. RCA Victor didn't care which it sold, discs or tapes, just so that the transaction was profitable. They had by that time quite an investment in tape duplicating equipment (Fig. 8) which suddenly wasn't very busy. So after a frantic several months, these machines were modified to make tapes at 3½ ips instead of 7½, and to lay down four tracks (two in each direction) instead of two on a ½-in. wide tape, while maintaining the same frequency response and almost the same with handling discs. As mentioned previously, Wyte, Frayne, and Davis of Westrex, prodded by Capitol Records' Ed Ueke and RCA Victor's Bill Miltenberg, worked on modernizing Blumlein's early vertical-lateral cutters concept. EMI in England also got busy doing the same.

Dr. Dutton (EMI) writes:

"The major recording companies in Europe met on November 28, 1957 at Zurich to pool our information and discuss the relative merits of the 45/45 vs. the hill-dale/lateral system. It was decided unanimously to recommend the 45/45 system and I then attended a meeting of the technical committee of the RIAA at Indianapolis at which I reported the recommendations of the European meeting and as you know these appeared to be in full agreement with those of the RIAA."

By April, 1958, nine companies in the U. S. were making and releasing 45/45 stereo discs. The 1958 NAMM Show in July was a clean sweep for stereo records. Stereo tapes and tape machines in general were to have their worst year. The 7½-ips two-track stereo tapes at $12.00 to $16.00 each were no match for stereo discs of the same tunes at $4.95 and $5.95. The two- and three-track master tape at the record company didn't care whether it made stereo tapes or stereo discs. But the people making tape machines cared a great deal! Something had to be done. A good stereo tape (sometimes hard to find) lasted for countless playings, and didn't have pops and ticks. RCA Victor didn't care which it sold, discs or tapes, just so that the transaction was profitable. They had by that time quite an investment in tape duplicating equipment (Fig. 8) which suddenly wasn't very busy. So after a frantic several months, these machines were modified to make tapes at 3½ ips instead of 7½, and to lay down four tracks (two in each direction) instead of two on a ½-in. wide tape, while maintaining the same frequency response and almost the same with handling discs. As mentioned previously, Wyte, Frayne, and Davis of Westrex, prodded by Capitol Records' Ed Ueke and RCA Victor's Bill Miltenberg, worked on modernizing Blumlein's early vertical-lateral cutters concept. EMI in England also got busy doing the same.

Dr. Dutton (EMI) writes:

"The major recording companies in Europe met on November 28, 1957 at Zurich to pool our information and discuss the relative merits of the 45/45 vs. the hill-dale/lateral system. It was decided unanimously to recommend the 45/45 system and I then attended a meeting of the technical committee of the RIAA at Indianapolis at which I reported the recommendations of the European meeting and as you know these appeared to be in full agreement with those of the RIAA."

By April, 1958, nine companies in the U. S. were making and releasing 45/45 stereo discs. The 1958 NAMM Show in July was a clean sweep for stereo records. Stereo tapes and tape machines in general were to have their worst year. The 7½-ips two-track stereo tapes at $12.00 to $16.00 each were no match for stereo discs of the same tunes at $4.95 and $5.95. The two- and three-track master tape at the record company didn't care whether it made stereo tapes or stereo discs. But the people making tape machines cared a great deal! Something had to be done. A good stereo tape (sometimes hard to find) lasted for countless playings, and didn't have pops and ticks. RCA Victor didn't care which it sold, discs or tapes, just so that the transaction was profitable. They had by that time quite an investment in tape duplicating equipment (Fig. 8) which suddenly wasn't very busy. So after a frantic several months, these machines were modified to make tapes at 3½ ips instead of 7½, and to lay down four tracks (two in each direction) instead of two on a ½-in. wide tape, while maintaining the same frequency response and almost the
Please send me the books I have circled below. I am enclosing the P. O. No. 112 Paper Cover $2.95*

The 4th Audio Anthology
This is the biggest Audio Anthology ever! Contains a wealth of essential high fidelity know-how in 144 pages of complete articles by world-famous authors. No. 120 $7.95*

McProud High Fidelity Omnibook
Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, where to's, and when to's, written so plainly that both engineer and layman can appreciate its valuable context. Covers planning, problems with decoration, cabinets and building hi-fi furniture. A perfect guide. No. 115 Paper Cover $2.50

Tape Recorders and Tape Recording
Harold D. Weiler
A complete book on home recording by the author of High Fidelity Simplified. Easy to read and learn the techniques required for professional results with home recorders. Covers room acoustics, microphone techniques, sound effects, editing and splicing, etc., invaluable to recording enthusiasts. No. 113 Paper Cover $2.95*

MONTHLY SPECIAL! SAVE $5.40
Save over 50% with this collection of AUDIO books. 4th Audio Anthology ($2.95) McProud High Fidelity Omnibook ($2.50) best of AUDIO ($2.00) Tape Recorders & Tape Recording ($2.95)

TOTAL VALUE OF ALL FOUR BOOKS $10.40
Your cost ONLY $5.00 POSTPAID
This offer expires June 30, 1962. Good only on direct order to Publisher. CIRCLEOS200

AUDIO Bookshelf - RADIO MAGAZINES, INC.
P. O. Box 629, Mineola, New York
Please send me the books I have circled below. I am encasing the full remittance of $................................. (No C. O. D. or Billing).

NAME
ADDRESS
CITY_ ZONE _ STATE

"The AUDIO Cyclopedia"
Howard M. Tramaine
Here is one single volume with the most comprehensive coverage of every phase of audio. Contains accurate explanations of all audio and hi-fi subjects. More than 7 years in preparation—the most authoritative encyclopedia work with a unique quick reference system for instant answers to any question. A vital complete reference book for every audio engineer, technician, and serious audiophile. No. 123 $19.95*

"The best of AUDIO"
edited by C. G. McProud
A new compendium of AUDIO knowledge. Here is a collection of the best of AUDIO—The AUDIO clinic by Joseph Giovanelli—... noted audio engineer and the original high fidelity encyclopedia—EQUIPMENT PROFILES edited by C. G. McProud—... Editor of AUDIO. Here is a wealth of hi-fi and audio information. Answers to the most important issues in high fidelity and a valuable reference on the performance of leading makes of high fidelity components. No. 124 Volume I $2.00*

Introduction to Hi-Fi
Clement Brown
An original, refreshing approach to hi-fi theory and practice—a typically British thoroughness to the discussion of pickups, preamps, amplifiers, speakers, acoustics, etc. —with an interesting prognosis of hi-fi in the future. The author is renowned British authority. His style contributes a fresh new look at hi-fi. 192 pages. No. 68 Paperback $2.20*

Stereo...How It Works
Norman H. Crowhurst
A well known authority writes on the exciting technology of stereo. Its theory and operating techniques including recording, playback, broadcasting, simulcasting, multiplexing. Covers stereo discs and tapes with a unique and practical approach. 224 pages. No. 80 Paperback $2.90*

Understanding Hi-Fi Circuits
Norman H. Crowhurst
One of the best known and highly popular technical hi-fi authors analyzes all the important circuits of a hi-fi system in this important book. Fully covers all types of audio circuits: inverter, driver, output stages, feedback, damping—plus much more. A valuable reference for the student, hobbyist and technician. 224 pages. No. 64 Paperback $2.90*

Basic Audio Course
Donald C. Hoefler
This book is written for the hi-fi enthusiast who wants to venture into the exciting technical side of hi-fi components. Covers the fundamentals of audio and high fidelity systems from preamp to loudspeaker—the nature of sound—analyses of components—recording techniques. 224 pages. No. 66 Paperback $2.75*

Maintaining Hi-Fi Equipment
Joseph Marshall
A valuable reference for anyone whose living or hobby is servicing hi-fi equipment. Outlines the professional approach for servicing all types of hi-fi components. Covers trouble-shooting of electrical, mechanical and acoustic problems. 224 pages. No. 50 Paperback $2.90*

Registering Hi-Fi Circuits
Herman Burstein
A well known authority writes on the exciting technology of stereo. Its theory and operating techniques including recording, playback, broadcasting, simulcasting, multiplexing. Covers stereo discs and tapes with a unique and practical approach. 224 pages. No. 80 Paperback $2.90*

No. 112 Paper Cover $2.95*

No. 88 Paperback $3.20*

No. 80 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 80 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*

No. 88 Paperback $2.90*

No. 84 Paperback $3.20*
TRU-FI TONE ELIMINATES ALL SPEAKER DISTORTION!

YOU eliminate distortion in even the most elaborate speaker system with a TRU-FI TONE. This easily-installed unit (no soldering required) stops distortion originating in your speaker system and improves tone quality by a new method of back pressure control. Satisfaction guaranteed or your money refunded. No COD. Only $5.95 postpaid. (Calif. residents add 24¢ sales tax.)

A TRU-FI TONE USER WRITES...

... Even increasing the bass 15 db did not create any discordance ... Higher notes also were improved ... one of the best investments I have made in my system.

E. Earl Wagner, Washington, D.C.

DAVID ARDEN ENTERPRISES
4327 Fairmount Ave., San Diego 5, Calif.

Circle 93A

Chief Fidelitone

ingredient:

QUALITY

We don’t use just diamonds—we use gem stone quality diamonds. And it’s the same with each component of each Fidelitone diamond needle. The finest materials, engineering talent, and workmanship—all combine to assure you of quality needles for quality sound reproduction equipment.

When you need a needle, get quality—specify Fidelitone—on top since 1929.

Fidelitone

“Best buy on records”
Chicago 26, Illinois

Circle 93B

The Fairchild 661

AUTO-TEN

...A NEW REVOLUTIONARY AUTOMATIC ATTENUATOR®

The new Fairchild Model 661 AUTO-TEN now becomes your “third hand” for complex mixing and level control problems. This completely transistorized automatic attenuator can perform level control functions many times faster than the speed of the human hand.

The attack time of 40 milliseconds and the variable release time of from 3 seconds to 7 seconds assures greater flexibility, accuracy, and reliability. The Fairchild 661 handles impedances from 150 to 47,000 ohms without distortion or frequency discrimination and can automatically attenuate up to 60 db. The Fairchild 661 is the ultimate solution to:

- Noise reduction in film recording and multi-track tape playback
- Maintaining silence in LP spirals
- Automation of broadcast channels
- Improvement of separate studio mixes
- Minimizing feedback in PA systems.

Fairchild 661 AUTO-TEN $125.00

*Patent Pending.
Write for complete descriptive literature.

FAIRCHILD RECORDING EQUIPMENT CORPORATION
10-40 45th Ave., Long Island City 1, N. Y.

Circle 93D
Purchasing a Hi-Fi System?

Time Payments Available
Up to 2 years to pay!

Send Us Your List of Components
For a Package Quotation

Airex
Purchasing Radio Brand New, Factory
Under Sold

Won't Be

$10.00 Each Postpaid

Time Payments Available

Radio Magazines, Inc.

System?

U. S. Delivery Only

Offer Now

Limited Number Available

$10.00 Each Postpaid
U. S. Delivery Only

Send Order and Remittance Today

Book Division
Radio Magazines, Inc.
P. O. Box 629
Mineola, N. Y.

Others from their brain waves, are terrif-

mendous! Some of them are described in the

book!

It's going to be fascinating to see what
does come next, isn't it?

References

1. Read, Oliver, and Welleh, W. L., "From

Tinfoil to Stereos," Hourly W. Sams, San-

napolitana, Indiana, 1959, pp. 449, 475.

2. Maxfield, J. P. and Harrison, H. C.,

"Methods of high-quality recording and

 reproducing of music and speech based on

telephone research," Trans. AIEE, Febru-

ary, 1926.

3. Maxfield, J. P., "Liveness in broadcast-

ing," Western Electric Oscillator, No. 6,
January 1947.

4. Dutton, G. F., "Stereo on disc," Hi-Fi

5. (a) Bell Telephone Laboratories, "The

production of orchestral music in audi-

tory perspective," Bell Telephone Labo-

ratories Record, Vol. 11, No. 10, June
1958; Reprinted, Audio, June 1957.

(b) Fletcher, H., "An acoustic illusion

telephony actually achieved," Ibid; Re-

printed Audio, July, 1957.

(c) Snow, W. B., "Auditory perspec-

tive," Bell Telephone Laboratories Rec-

ord, Vol. 12, No. 7, March, 1934; Re-

printed Audio, August, 1967.

(d) Bedell, E. H., "Auditorium acous-

tics and control facilities for reproduc-

tion in auditory perspective," Ibid; Re-

printed Audio, Sept., 1957.

(e) Thomas, A. L., "Language speakers and

microphones for auditory perspective,"
Ibid; Reprinted Audio, October, 1957.

(f) See also: "Symposium on auditory

perspective," ibid; Reprinted AUDIO, Oc-

tober 1957.

QUALITY TAPES DISCOUNTED 75%!

Recording catalog: taped King 2028 Garth,
Los Angeles 24, California.

FIVE PLEASANT SURPRISES! Then

write us before you purchase any hi-fi. You'll

be glad you did. Unusual savings. Key Elect-

ronics, 129 Liberty St., New York 6, N. Y.

C-5-9288.

High Fidelity Speakers Required

Aimee Speakman
First Floor
165 West 23rd Street, New York 11, N. Y.

CIT 6-3712.

Audio • may, 1962

www.americanradiohistory.com
OLD PRODUCTS

(from page 78)

- **Magnetic Guttridge**. Fairchild Camera and Instrument Corporation has announced an improved magnetic guttridge, the Unit $144, with an additional mounting plate for any current model sound recorder. It is designed to meet the highest quality standards of both AM and FM broadcasting and professional recording.

Being exceptionally free from harmonic distortion, clean-out recordings may be made at a level to give high signal-to-noise ratio. (May, 1947)

- **Automatic Turntable**. Arnold B. Hartley, Program Director of WOV, and Hills W. Holt, WOV Manager of Technical Operations, have received U. S. Patent No. 2,447,443, issued to them on their mutual invention, the Hartley-Holt Automatic Turntable. The purpose of the device, invented during the recent war, is to permit the playing of either 78- or 33⅓-rpm records without the necessity of changing turntable speed. The Hartley-Holt table consists of a 12-inch inner table rotating at 78 rpm, surrounded by a 3-inch outer ring, slightly raised above the inner table and rotating at 33⅓ rpm. 16-inch discs therefore automatically are turned at the slow speed, and discs 12-inches or less in diameter turn at the fast speed. More than 95 per cent of all existing discs can thus be played without manipulation of any kind to set or change speed. (May, 1947)

**FM/C ANTENNAE**

THE FINEST OF ITS KIND . . .

Get more FM stations with the world's most powerful FM Antenna systems.

To be fully informed, send 30¢ for book "Theme And Variations" by L. F. Carle and containing FA Station Directory.

**APPARATUS DEVELOPMENT CO.**

WETHERSFIELD 9, CONN.

**MAIL ORDER HI-FI**

COMPONENTS RECORDERS TAPES

At wholesale prices. Shipped within 24-28 hrs.

We'll arm low quotes on packaged Hi-Fi.

**LONDON CALLING THE WORLD . . .**

KEEP HI-FI COSTS LOW—buy BRITISH EQUIPMENT from the United Kingdom Mail Order Specialists!

Example: GARRARD 301 transcription motor delivered to your door for $65.75.

All goods packed, insured and shipped promptly at minimum cost. Send us details of your needs!

C. C. GOODWIN (Sellers) Ltd. (Dept. A)

Circle 95D

**SAVE UP TO 40% on HI-FI COMPONENTS AND PACKAGES**

- 15 Day Money Back Guarantee
- EASY PAY PLAN—UP TO 24 MONTHS TO PAY
- WE GUARANTEE WE WILL NOT BE UNDERSOLD

Please write for FREE return mail quotation, and wholesale catalog. Also pre-recorded tape catalog on request.

**Circle 95H**

**CANADA**

High Fidelity Equipment
Complete Lines • Complete Service
Hi-Fi Records — Components and Accessories

**ELECTRO-VOICE SOUND SYSTEMS**

126 DUNDAS ST. WEST, TORONTO, CANADA

**Circle 95G**

**EXECS—ENGINEERS**

Grows New JOB Fast!

Boosts Pay $6000 a Yr.

Phil B. of Chicago says, "I got just the job I'd always dreamed about—a $6000 a year increase! I selected the best job in my field from 7 offers in only 90 days using your proven secret methods." Another B & D Engineer just moved to Section Chief at DOT/Radio Tech Pay: a Sr. Eng' at $10,000 went to Chief at $15,000; a Gen' Mgr. at $12,000 is now VP at $23,000 plus stock and bonus.

New Opportunities $10,000 to $50,000

You too, can get the Best Job in Your Field Rapidly and Confidentially this Proven Way. Protects Your Identity, Contacts 8-11, the Firms in your field to Get You Top Pay, Unusual Opportunities and Personal Satisfaction.

Talk with an Engineer who understands your situation and knows your fields. Send your Resume in Confidence Now for Review and YOUR PERSONAL PROVEN ACTION PLAN—by an Engr. (EE in 35 and ex-W9BMT since 1926) and Seasoned Executive (R&D, Kellogg, Weboe) and Qualified Consultant with 31 years of Personal Top Level Nationwide Contacts. Ask for New "Check-Chart to Evaluate Job Benefits".

Write or Call Now—Mich 2-2532

Mr. Wm. V. Baker, Suite 1612A
Nat'l Electronics Exch.
29 E. Madison Bldg., Chicago 2, Ill.

Circle 95A
LAFLAYETTE STEREO HI-FI COMPONENTS

DEDICATED TO MUSIC

Made in U.S.A.

LAFLAYETTE LT-700 Criterion FM STEREO MULTIPLEX TUNER

NO MONEY DOWN 124.50

Ready for Stereo and no Adapter Needed. Opening a new era in stereo, the new Lafayette Criterion FM Stereo Multiplex Tuner is entirely self-contained with its own built-in multiplex facilities. Capable of achieving the highest Laboratory Standards, its exceptional selectivity and sensitivity together with drift-free AFC performance assures effective reception of even the weakest multiplex or monaural FM signals.

KT-250A 50-WATT INTEGRATED STEREO AMPLIFIER

KT-250A

74.50 99.50

In Kit Form Complete ly Wired

• 3rd Channel Output
• Separate Base & Treble Controls
• 50-Watts Monophonically - 25 Watts Each Channel
• Response: 15-40,000 cps ± .5 db (at normal listening level)

Pacsetting quality, performance and design. Features include: unique "Blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phase switches. Also provides outputs for 4, 8, and 16 ohm speakers. Hum-free operation is insured by use of DC on all pre-amp and tone control tubes. Individually biased and balance controls. Harmonic distortion, less than 0.25%. IM distortion, less than 5%. Hum and noise 77 db below full output. 141/2"W x 121/2"D x 51/2"H. Shg. wt., 28 lbs.

KT-600A Criterion PROFESSIONAL STEREO CONTROL CENTER

KT-600A

LA-600A

79.50 134.50

In Kit Form Complete ly Wired

• Response 5-40,000 cps ± 1 db
• Precise "Null" Balancing System
• Bridge Control Provides Variable 3rd Channel Output
• Variable Cross Channel Signal Feed Eliminates Hole-In-The-Middle Effects
• Tape Road Playback Equalization for 6-Track Stereo

Sensitivity 2.2 mv for 1 volt out. Dual low inductance "plate follower" outputs 1500 ohms. Less than 0.3%. IM distortion; less than 1%. Harmonic distortion. Hum and noise 30 db below 2 volts. 141/2"H x 121/2"D x 6"H. Shg. wt., 16 lbs.

KT-550 Criterion 100-WATT BASIC STEREO AMPLIFIER

KT-550

LA-559

134.50 184.50

In Kit Form Complete ly Wired

SYOSSET, L.I., N.Y. JAMAICA 33, N.Y. NEW YORK 12, N.Y. BROOKLYN 56, N.Y. Weymouth, 7, N.Y. FARMINGDALE, N.Y. BOSTON 10, MASS.

FREE YOURS FOR THE ASKING!

SEND FREE 1962 Catalog featuring the complete line of Lafayette Stereo Components.

LAFAYETTE RADIO Dept. AE-2 P.O. Box 10 SYOSSET, L.I., N.Y.

Name ____________________________ Address ____________________________

City __________ Zone __________ State ____________________________

ADVERTISING INDEX

Acoustic Research, Inc. 57
Airex Radio Corporation 39
Allied Radio 89
Altex Lansing Corporation 69
Amplify Electronics Co. 87
Apparatus Development Co. 95
Arlen, David, Enterprises 97
Audio Bookshelf 92
Audio Dynamics Corporation 93
Audio Exchange 93
Audio Fidelity Records 71
Audio Unlimited 95
Barker & Williamson, Inc. 88
Bell Stereo 43
Bell Telephone Laboratories 19
Benjamin Electronic Sound Corporation 55
Bobak Speakers 94
British Industries Corporation 3
Carston 95
Classified 94
Dynaco, Inc. 76
Eastman Kodak Company 63
EICO 13
Electro-Acoustics Products Company 63
Electronic Applications, Inc. 2
Electro-Voice, Inc. 82, 83
Electronic Voice Systems 69
Fairchild Recording Equipment Corp. 91, 93
Fidelitone 93
Fisherr Radio Corporation 9
Fisher Laboratories 49
Gardner Laboratories, Inc. 72
Crammers, Division of Precision Electronics, Inc. 73
Harman-Kardon 47
Hath Company 47
Hi Fidelity Center 95
International Electrocoustics Incorporated 37
International Electronics Corp. 6
Jensen Manufacturing Co. 49
Kesting Manufacturing Co. 95
Key Electronics Company 91
Lafayette Radio 96
Lensing, James B., Sound, Inc. 41
Magnetic Products Division, 3M Company 95
Multichrome Sales Corp. 95
Natl' Electronics Exch. 95
North American Phillips Co., Inc., Cov. 11
Paco Electronics Co., Inc. 45
Pickering & Company, Inc. 59
Pilot Radio Corporation 59
Pioneer Electronic Corporation 53
Rel-O-Kut Co., Inc. 51
Roberts Electronics, Inc. 55
Robins Industries 85
Rockbar Corporation 87
Sarkes Tarzian, Inc. 57
Scott, H. H., Inc. 71
Sherwood Electronic Laboratories, Inc. 61
Shure Brothers 67
Sonotone Corporation 87
Sovovix Co., Ltd. 91
Superscope, Inc. 71
Tandberg of America, Inc. 2
Tannoy (America), Ltd. 3
Technics, Div., Edna Marketing Industries, Inc. 40
Transis-Tronics, Inc. Cov. IV
United Audio 14
University Loudspeakers 11
Wilder Engineering Products 86

AUDIO • MAY, 1962

www.americanradiohistory.com
This is Sony.

THE MOST COMPLETE LINE OF QUALITY TAPE RECORDING EQUIPMENT IN THE WORLD

- SONY Stereocorder 300—A complete professional-quality hi-fi stereo tape system with 4 & 2 track recording and playback in one portable unit, $599.50. - SONY Stereocorder 777—All transistorized professional stereo recorder featuring exclusive Sony Electro Bilateral 4 & 2 track playback head. World's finest tape recorder. $595.
- SONY Sound on Sound Recorder 262 SL—The perfect recorder for language, music and drama students. 4 track with stereo playback. $199.50.
- SONY Stereocorder 464 D—Dual performance 4 track stereo tape system with 4 & 2 track recording and playback in stereo tape deck with built-in recording & playback pre-amps for custom installations and portable use, $199.50.
- SONY Sound on Sound Recorder 262 D—4 & 2 track stereo recording and playback tape transport to add tape to your existing hi-fi system, $89.50. (Also available, not pictured, the new SRA-2 stereo recording amplifier for the 262 D, $89.50.)
- SONY Tapesocorder 111—A popularly priced, high quality bantam recorder for everyday family fun, $79.50.
- SONY Portable 101—2 speed, dual-track, hi-fidelity recorder with 7” reel capacity, $99.50.
- SONY Stereocorder 464 D—Dual performance 4 track stereo tape deck with built-in recording & playback pre-amps for custom installations and portable use, $199.50.
- SONY Executive Portable 801—Handsome-styled battery operated precision recorder for executive desk or portable use, $295.
- SONY Newscaster Portable EM1—A professional on-the-spot battery powered portable recorder with precision spring wind constant speed motor, $495.
- SONY Condenser Microphone C37 A—For purity of sound reproduction, the unqualified choice of professional studios throughout the world, $295.
- SONY Condenser Microphone C17 B—Miniature size (3½” X ½” diameter) and exceptional background isolation uni-directional cardioid pattern, $350.
- SONY Wireless Microphone CR-4—Pocket size mike and transmitter providing complete freedom from entangling microphone cables, $250.

For additional literature and name of nearest franchised dealer write Superscope, Inc., Dept. 7
Sun Valley, California

www.americradiohistory.com
TEC'S TAKEN TUBES OUT OF TUNERS!

High fidelity's first all-transistor FM tuner... quite naturally from Trans-Tronics. Never before has there been such high quality in a small package utilizing the most advanced form of miniaturized electronic circuitry. Plus TEC's famous efficiency—power drain is only four watts making mobile use possible. Check off the features... meter tuning for accurate station location... less than one microvolt sensitivity for 20db of quieting... synchronous gate multiplexer based on advanced computer and space telemetry design... delivers maximum channel separation... adjustable muting. Available with or without multiplex or in combination with TEC's world-famous S-15 amplifier packaged in a beautiful oiled walnut case. Hearing is believing. Write for complete specifications on both units.

TRANSTRONICS, INC., 1501 W. JEFFERSON BLDG., SANTA MONICA, CALIFORNIA