NEW CIRCUITRY, NEW FEATURES, NEW IDEA IN STEREO

"Modern" is not the word. Perhaps "ahead-of-its-time" is a bit more descriptive of the new Altec 708A "Astro." How else would you describe an all-in-one stereo center full of features and facilities never before available in a single package?

For example, consider its circuitry. Transistors are combined with new frame grid tubes to gain the best qualities of each. As another example, consider its unique stereo headphone facilities. The output receptacle is in the rear; you may leave the headphones plugged in permanently, out of sight when not in use. The headphone switch, however, is located conveniently on the front panel.

Or, consider the unique tape recording monitor that functions much like monitors in professional recording studios. Namely, it permits you to monitor any source material two ways during recording: the instant signal enters the record head or directly from tape, the moment it is recorded. And these features are only a sampling. Truly, the "Astro" is "ahead-of-its-time" even down to the smallest details such as the exclusive friction-lock controls that obsolete awkward dual knobs found on conventional stereo equipment.

COOLNESS OF TRANSISTORS—PRECISION OF FRAME GRID TUBES

For cool operation, Altec makes judicious use of transistors. For highest sensitivity and quietest performance imaginable, new ultra-precise frame grid tubes are used. This proper combination of transistors and tubes in the "Astro" has produced results that are just this side of miraculous.

The "Astro" is sensitive, stable and completely consistent in its performance (top-notch!) and utterly free of drift. Indeed, it is the first truly practical stereo center because transistors in the power stage make it run cool for hours on end. Unlike ordinary "hot boxes," the "Astro" secures peak operating efficiency and maximum life from resistors, capacitors, and other sub-components in its circuitry. And, because it runs cool, the "Astro" is the first practical unit for built-in installations.

WHAT MAJOR COMPONENTS ARE INCLUDED IN THE NEW "ASTRO"?

Five integrated stereo components are packaged in a compact 6" x 15" x 13½" cabinet: FM, FM multiplex, AM, dual-channel preamplifiers, dual-channel power amplifiers. The wide band FM tuner features 1.5 microvolt sensitivity (equivalent to 0.75 microvolts with matched 72 ohm antenna) to assure highest gain, lowest noise. A built-in FM stereo multiplex receiver provides 30 db stereo separation between channels over the entire audio range. To take all guesswork out of tuning, a monitor light goes on automatically when stereo signal is received. The AM tuner provides high sensitivity and excellent image and IF rejection.

The preamplifier section features a complete complement of controls and includes facilities for everything from record and tape player to the stereo headphones. Powerful dual-channel amplifiers deliver 25 watts each down to 20 cycles (IHFM standard) with ±1 db, 20-20,000 cps frequency response.

YOU MUST SEE & HEAR THE "ASTRO"

Feel it, too, for that all-important coolness. At your Altec Distributor's now. Or, for information, write Dept. A3
March, 1962 Vol. 46, No. 3
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Internal Circuit Grounding

Q. I would welcome information on the following question. In reading articles in Audio and other magazines, there appears to be two schools of thought in regard to grounding of amplifiers. Some schools agree that the internal circuit ground should be made to the chassis at one point only, usually at the input jack. One school uses regular hookup wire to run separate wires from each component to the single ground point. The other school uses a single, heavy ground bus, grounded at one point and run through the amplifier with the ground points tied on to it. It appears that the order of the grounding points on this bus is critical. My question is in two parts: 1. Is either method superior to the other? 2. In the ground bus method what order of grounding to the bus would be best for a first try? Arthur L. Stanhope, Haddonfield, New Jersey.

A. First of all, when constructing amplifiers, unless they are of the integrated type, containing the preamplifier together with the amplifier, I am not fussy about grounding. I often make chassis grounds at whatever point seems convenient to the particular circuit, and use neither method you mentioned.

When it comes to a circuit which has the gain possessed by a preamplifier and which must handle low-level signals, more care in grounding must be observed. Both the bus system and the hookup wire approach are good schemes. I don't think there is much to say for one method over the other. I prefer the use of the hookup wire rather than the bus since the bus makes for difficulties in laying out the parts in some instances. Notice that my preference is not based upon the relative hum-rejecting abilities of the two schemes. With extremely high-gain circuits, such as those required for some low-output tape heads, I believe that the hookup wire system possesses somewhat superior performance capabilities. This system is so wired that the ground for each stage is returned to the main ground point. This eliminates the possibility of hum loops being developed along the ground bus.

As for the order of ground placement when using the bus approach, there is a very simple explanation for this. You know that the end nearest the input handling the smallest signal is grounded to the chassis. This point is located near the first stage of the equipment. All grounds from the first stage are made to one point. Then comes the grounds for the second stage, the third stage grounds, and so on. I like to bring my filament grounds directly to the main ground—to the chassis—so that they won't cause hum voltage to be introduced along the line. It would be a good idea to return the B filter capacitor leads to this same, main ground point. The correctness of the power transformer is returned here also. These are some of the most important considerations in grounding circuit elements within an amplifier. By observing these precautions, you can produce virtually hum-free performance from your preamplifiers, providing that care is taken in filtering of B and filament supplies, and that hum is not picked in the input devices such as tape playback heads or phone cartridges.

When constructing hook-up systems you do not need to run a wire from each individual component to the main chassis ground. It is sufficient to run the grounds from each stage to a tie point and take this stage ground tie point to the main ground via hookup wire.

A.C. and D.C. Balance Circuits

Q. Many amplifiers have pot controls for d.c. balance of the output tubes. Many of the newer amplifiers are appearing with a.c. balance controls as well. What is the advantage or purpose of an a.c. balance control? How is it adjusted? Arthur L. Stanhope, Haddonfield, New Jersey.

A. Let's look at the push-pull output stage to see why we need the a.c. balance control. We want the d.c. adjusted in the push-pull amplifier so that equal current flows through each half of the output transformer. This will prevent saturation of the iron in the transformer. When the iron core of a transformer is saturated, the inductance of the transformer decreases. Therefore, these bass tones will not be able to handle the amount of audio which could otherwise be handled when the d.c. is correctly balanced. This previously-mentioned fall in inductance is likely to occur during low-frequency passages of the program. These passages contain the greatest amount of audio power. Therefore, these bass tones will not be reproduced cleanly.

It would also be nice if each half of the output stage of the amplifier would restore the same amount of signal from the driver. This would give maximum power output and minimum distortion because the push-pull action of the stage is correctly functioning. Not only is it a matter of the performance of the stage as a whole, but...
"Which cartridge do you recommend for the Type A?"
"Can I use the professional models?"

**THE ANSWER IS:** Use the cartridge of your choice
...any manufacturer, any model!

The arm on the Type A will bring out the best in any cartridge...tracking (and tripping) at the lightest pressure specified by the cartridge manufacturer. This includes the professional models, which were developed originally for separately-sold tone arms because of their high compliance. Now, Garrard integrates precisely such an arm into the Type A Automatic Turntable. This is a dynamically-balanced, counterweighted arm, designed and built with the same precision, the same balance, the same freedom from friction, the same playback characteristics and low resonance expected in tone arms separately sold, regardless of price. The Type A arm, operating in conjunction with a weighted, full-size, non-magnetic turntable; a laboratory-balanced, double-shielded motor; and (when you want it) the gentlest automatic record-handling mechanism ever designed; rewards you with the full measure of the magnificent reproduction achieved by any of the latest, finest, stereo cartridges. Extravagant concept, yes...but the price of the Garrard Type A Automatic Turntable is exceedingly modest, only $79.50.

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the Weathers Modern Trio . . . a complete, three channel stereo speaker system which gives full stereophonic reproduction in every part of any size room. It consists of two full range speakers and a unique Hideaway non-directional speaker that is completely concealed from view. You can place it anywhere — and still be sure of superb performance. The Modern Trio is the smallest and most efficient stereo speaker system yet devised. It fits any size room and blends with any decor. It produces to perfection all stereophonic recordings and adds greater depth to monaural discs.

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the finest performance per unit of cost in stereo cartridges.

Also it is a matter of the performance of the transformer. If one half of the transformer is driven harder than the other half, it is obvious that magnetizing forces will not cancel out, and the transformer will be more quickly saturated than it would otherwise be. In order to determine whether the grids of the output tubes are receiving equal signal, you can measure between grid and ground of each tube. If they are not receiving equal signal, what can you do about it in most amplifier circuits? The answer is, of course, nothing at all. Only in those amplifiers containing an a.c. balance control can this condition be corrected. The a.c. balance control makes it possible to adjust the input so that each grid does get the same amount of signal.

The a.c. signal conditions discussed here are not applicable to the output stages of amplifiers only. They hold true for any push-pull stage. Of course excellent performance may be obtained without the a.c. balance control. The use of this type of balance circuit merely imparts the final touch to the equipment — the frosting on the cake as it were.

The Yagi Antenna

What is a Yagi antenna? Nario Brener, Brooklyn, New York.

A. A yagi antenna is one of a group of antennas known as parasitic arrays. The yagi consists of a dipole, a reflector, and several directors mounted on a boom. To make this arrangement more clearly understandable, consider a heavy rod. At one end of this rod is mounted another rod, this one being much shorter than this first rod, or boom. If it is mounted at right angles to the direction of the boom, near the rod is mounted a dipole — either folded or straight. The physical length of the dipole is slightly less than that of the first rod. The first red is known as a reflector; the dipole is known as the driven element. Spaced along the remainder of the length of the boom are mounted one or more additional rods, or elements as they are called. These will each be shorter than the dipole, and are known as directors.

Somewhere near the center of gravity of this array, a clamp is attached which enables the array, or beam, to be mounted to a mast. Sometimes, rather than being mounted directly on the mast, it is mounted on a rotator. Wires are run from such a rotator to some convenient point near the equipment with which the yagi is associated. The wires are connected to a control box which operates the rotator, and which is provided with some means whereby the direction the yagi points to can be determined. Rotating the antenna and knowing the direction in which it is pointed are very important facets of the total picture of the yagi, as will shortly be seen.

The end of the boom furthest away from the driven element is the end which points to the desired direction.

What is the purpose of this? It strengthens the signals received. In other words, let us assume that you are interested in receiving a weak FM station. Your dipole did not work well enough to give you really good limiting. The yagi antenna will probably give you sufficiently greater signal strength to enable the listener to receive the station with no background noise. The yagi accomplishes this by means of a focusing action of the elements; focusing maximum signal on the dipole portion of the array.

However, this is done with some sacrifice. You somehow never do get something for nothing. Your original dipole would receive signals from two directions in a cardiod (Continued on page 38)
Let's face it...

4-track stereo does challenge tape quality!

SCOTCH® BRAND RECORDING TAPES MEET THE CHALLENGE WITH OXIDE "POWER," HIGH DIMENSIONAL UNIFORMITY!

New 4-track stereo, with dramatic improvements in sound reproduction and tape economy, puts tape quality to the test—makes the exceptional quality of "SCOTCH" BRAND Recording Tapes more important than ever. For example...

Narrow, quarter-width tracks mean that oxides must work harder, and the high-potency oxides in "SCOTCH" Recording Tapes do just that—permit thinner, more flexible coatings that make intimate head-to-tape contact a certainty.

With 4-track equipment, tiny variations in tape thickness (unnoticed in previous recording systems) may be magnified into level variations, distortion, other sound failures. "SCOTCH" Recording Tapes meet this demand with microscopic precision of both coating and backing thickness—assure identical full-frequency response with wide dynamic range inch after inch, reel after reel. Width, too, is held to a close tolerance to assure proper track alignment. And exclusive Silicone lubrication provides lifetime protection against wear for delicate 4-track heads. To make the most of 4-track stereo (two- and full-track recording, too), insist on the tape that's the performance standard of the recording industry..."SCOTCH" BRAND.

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Resonance well below audible frequencies. Interchangeable pivots keeps stylus vertical for any height adjustment. Unique vertical position slide; balancing counter-weight. 4-pin cartridge shells. Mounted on board for THORENS TD-124, SHUTS OFF AUTOMATICALLY AT END OF RECORD.

THORENS TD-135, COMPLETE WITH INTEGRATED ARM

For the first time, THORENS - in the new TD-135 - offers a component-quality arm and turntable mated with a precision that insures you perfect tracking, perfect sound... always... with a minimum of installation effort on your part.

There's no compromise whatever with quality such as you usually find in integrated turntable and arm units. THORENS TD-135 is Swiss-precision crafted throughout... true component-high fidelity all the way. You get: A precision turntable featuring 4 speeds, all adjustable, with an 8-pound non-magnetic table... plus a completely new, advanced tone arm that's so good we also sell it separately (see below) for use with any turntable of your choice. Exceeds NAB specs for wow, flutter and rumble. Has same belt-plus-idler drive as famous TD-124. Shuts off automatically at end of record. Many, many more features than we can detail.

$110 NET

THORENS BTD-12S, 12" PROFESSIONAL TONE ARM

Identical arm included with TD-135, but sold as separate unit. Less than 0.5"/inch tracking error. Built-in cueing device. All adjustments: vertical height; calibrated gram-force; stylus positioning slide; balancing counter-weight. Unique vertical pivot keeps stylus vertical for any height adjustment. Resonance well below audible frequencies. Interchangeable 4-pin cartridge shells. Mounted on board for THORENS TD-124, TD-121 turntables.

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THORENS DIVISION
ELPA MARKETING INDUSTRIES, Inc.
New Hyde Park, N. Y.

LETTERS

Higher Harmonics

SIR:

In the January "Letters" column Mr. Richard Simonton stated that he has yet to examine an electronic organ with harmonics higher than 7000 cps. Mr. Simonton, at least three organs (Allen, artisan, and the new Rodgers) have fundamentals up to 8372 cps and some of the mixture stops may have even higher fundamentals. Obviously, the second harmonic of these fundamentals is in the region of 16,000 cps, which is not difficult to achieve since these notes are not pure sine waves. Some of the reeds and strings may actually have harmonics as high as 20,000 cps.

ALLEN A. HIBBEEK
2504 Alondra Lane
Redondo Beach, Calif.

Electronic Organs

SIR:

There are some misleading statements in Mr. Wolkow's article in the February issue. First of all, organs which sell for $30 are not really electronic organs - they are reed mechanisms with motor-driven blowers which at best may use electronic amplifiers. The most inexpensive electronic organ I know of sells for $300-400. Secondly, Table 1 does not clearly indicate that a pipe of the length shown will produce only the top frequency in the column. For other notes, frequency and pipe length are inversely proportional. However the table is misleading in that the pipe lengths shown generally refer to pitch registers over an entire manual. For example, a 16-foot register would include notes beginning at 527 cps (produced by a 22-foot pipe), plus 5 additional octaves. Thirdly, the author's conception of scale mathematics seems inaccurate. The frequency of each note is the same as that of the previous note multiplied by the 12th root of 2. This ratio produces the correct, tempered scale. Fourths and fifths are "mistuned" to achive the relationship mentioned, not to result in altering it. Briefly stated, the scale is based on a frequency ratio of 2, the octave. The ear hears pitch increments and decrements logarithmically. Thus, to divide a ratio of 2 into 3 parts which will be exactly equal as perceived by the human brain, the factor becomes the 12th root of 2. The reason a tuner hears beats between fourths and fifths is that in this tempered scale the numbers arrived at are irrational, bearing no whole-number relationship.

RICHARD M. BORZ, President
The Schober Organ Corp.
43 West 61st St.
New York, N. Y.

He Wants Meat

SIR:

I have looked at the instruction manuals of kits built by friends and find that they are complete as to step-by-step assembly but do not give any information on the "whys." I do not intend to become an engineer but would like to know a great deal more about how my set operates.

The question remains, "How can manufacturers be convinced that many people in my category want more meat to chew on?"

DON E. McWINTER
1205 Tyler St.
Glendale 3, Calif.

(Simple—write to them! Ed.)

What and Why

SIR:

Anyone who is adept with his hands can do a creditable job in building kits—if he follows the instructions. But after a few kits he wants to know what and why as well as how. I feel that a better understanding of what and why will increase his understanding and enjoyment of music just as a person who understands the basic functions of an automobile makes a better driver.

R. C. McGINTY
84-29 Marriott Ave.
Jamaica 35, N. Y.

AUDIO • MARCH, 1962
"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'
PROFESSIONAL Monophonic Tape Recorder
gives you...Fulltrack or Halftrack * Hi/Lo Impedance input switching * 8/600 Ohm Balanced Output
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* Signal to Noise Ratio: 50 db below recorded "0" level. * Tape Speeds: 7½" or 3¼" per second. * Wow and Flutter: Less than
0.18% RMS. * Heads: In line record/playback head in shielded housing; full track or ½ track available. * Motor and Drive: Preci-
sion 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
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Size: 7" maximum (up to 2400" of tape). * Dimensions and Weight: 15¼" x 14½" x 9¼" 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

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The symbol ♩ indicates the United Stereo Tapes 4-track 7 ½ ips tape number.

Stereo 35/MM Volume 2

Command RS 831 SD

Ordinarily, records that sound good on equipment of modest frequency range, sound even better when transferred to wide-range equipment of modest frequency range, sound equipment whose response is flat enough to satisfy the disinterested listener. Last November, I made a point of the fact that Command's wide-range, barely noticeable on a system of limited response, was too evident on the set up I use every day for review of the show's first stereo release had impressed me with the sound of the upper regions of the scale; a French horn sat back a bit, the piccolo and Doc Severn's trumpet roam freely, while the more recent ones have adopted the Hollywood custom of stressing one or two themes. The music from the Robert Wright-George Forrest musicals seems to go with the more reasonable sound of two pianos, harpsichord, celesta and strings. Diamond has shown that the score is not quite prepared to accept it. The American Rodgers and Hammerstein pops, with a sound track as sure as the vision of the composer, Sincere World War 2, the burgeoning European movie industry has been sending an increasing number of films to this country. The more recent ones have adopted the Hollywood custom of stressing one or two themes in the background score, thereby making possible the tape album now issued by Leo Diamond. We can't complain of a novelty of Hollywood movie music on records or tapes, it is, after all, comprehensible music. Mayfair and Loope's "My Fair Lady," is voiced in Rosemary, A Secretary Is Not a Toy is one of the most stirring in the record industry. If the market is not the fault of the record company, Ray Ellis has appeared in several Victor albums but Robert Mersey is making his record debut in the Keen sound. Ellis elects a swinging approach in all the bright pieces from Frank Loesser's "How to Succeed." A wordless chorus backs up the beat of Love From A Heart of Gold, Happy to Keep His Dinner Warm, and Helen a Long Day. A few phrases are sung in the three tunes; the rhythm is voiced in Rosemary, A Secretary Is Not a Toy is one of the most stirring in the record industry. If a production shows promise, we then see a mixture of the records of these two sounds. Both show us a fine, sophisticated treatment of the material, and much more work is being done in new scores. This is a minor ·piece such as King of Kings and Other Film Themes.

Robert Mersey: Keen Columbia CS 8532

Once a record firm acquires the right to release the catalog recording of a Broadway show, other decisions remain to be considered. There's one easy way to learn what a record label really thinks of a musical. It has under its wing. If a production show promises while still under construction, then when the moment of the program are relaxed treatments of Irving Berlin's The First Time and Ben Barnes' old house song, It's a Lonely Old Town.

Ray Ellis: How To Succeed in Business RCA Victor LPS 2493

Robert Mersey is making his record debut in the Mercury recordings for artillery and orchestral music. The music from the Robert Wright-George Forrest musicals seems to go with the more reasonable sound of two pianos, harpsichord, celesta and strings. Diamond has shown that the score is not quite prepared to accept it. The American Rodgers and Hammerstein pops, with a sound track as sure as the vision of the composer, Sincere World War 2, the burgeoning European movie industry has been sending an increasing number of films to this country. The more recent ones have adopted the Hollywood custom of stressing one or two themes in the background score, thereby making possible the tape album now issued by Leo Diamond. We can't complain of a novelty of Hollywood movie music on records or tapes, it is, after all, comprehensible music. Mayfair and Loope's "My Fair Lady," is voiced in Rosemary, A Secretary Is Not a Toy is one of the most stirring in the record industry. If a production shows promise, we then see a mixture of the records of these two sounds. Both show us a fine, sophisticated treatment of the material, and much more work is being done in new scores. This is a minor ·piece such as King of Kings and Other Film Themes.

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King of Kings and Other Film Themes Repulse RSL 1706

Leo Diamond: Foreign Film Themes

Impacted cars have not been the only European products gaining wide circulation in this country recently. The attempts to place the label's technical resources in the Hollywood custom of stressing one or two themes in the background score, thereby making possible the tape album now issued by Leo Diamond. We can't complain of a novelty of Hollywood movie music on records or tapes, it is, after all, comprehensible music. Mayfair and Loope's "My Fair Lady," is voiced in Rosemary, A Secretary Is Not a Toy is one of the most stirring in the record industry. If a production shows promise, we then see a mixture of the records of these two sounds. Both show us a fine, sophisticated treatment of the material, and much more work is being done in new scores. This is a minor ·piece such as King of Kings and Other Film Themes.

King of Kings and Other Film Themes Repulse RSL 1706

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The Fisher KX·200 80-Watt Stereo Control-Amplifier StrataKit, $169.50.*

THE FISHER

Strata Kit,

$169.50.*

The Fisher KX·200 SO·Watt Stereo Control·Amplifier

It has four things that others haven’t.

1. **Strata Kit Construction.** Assembly by totally error-proof stages (strata). Each stage corresponds to a separate fold-out page in the Instruction Manual. Each stage is built from a separate transparent packet of parts. Major components come already mounted on the extra-heavy-gauge steel chassis. Wires are pre-cut for every stage—which means every page. Result: Absolutely equal success by the experienced kit builder or the completely unskilled novice!

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3. **Third-Speaker Output with Volume Control.** Blends the two stereo channel outputs to feed a third loudspeaker system—at any desired volume level. Ideal for center-channel stereo fill-in or for a mono extension speaker in another room of the home. A Fisher exclusive among control-amplifier kits.

4. **The Fisher Name.** No comment necessary.

---

*Walnut or Mahogany cabinet, $24.95. Metal cabinet, $15.95. Prices slightly higher in the Far West.

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SHOW THE CROSSTALK!

America is taking to our new Luxor Stereo tape recorder like Swedes take to Smorgasbord. Among the big factors in the success of this complete stereo sound system is its great crosstalk rejection ability. This means that the port and starboard speakers in your stereo system pull their share of stereo from the tape and nothing more. Made with traditional Swedish care, the Luxor Magnefon has less crosstalk than a pair of glaciers. It does however system pull their share of stereo from the tape and nothing more. Made with traditional Swedish care, the Luxor Magnefon has less crosstalk than a pair of glaciers. It does however system pull their share of stereo from the tape and nothing more.

MONTANA: Music of Victor Herbert and Sigmund Romberg

Mantovani recordings have been a vital segment of the London catalog during all the years of the LP record but a surprising number of them are available only in mono versions. At first glance, this release—and a companion disc called "Music of Irving Berlin and Rudolf Friml" (London PS 166)—seemed to me as another example of duplication until I discovered that not only have composers had undergone stereo treatment in Mantovani albums. If the orchestra's arrangements have changed since mono days, it would take a battery of experts to establish the point. Woodwinds are now sharing some of the prominence once reserved for the strings. Of course, Mantovani's string section still has plenty of prominence if you hear it under the conditions of preemphasis used on four-track tapes. The recording curve in these discs, fortunately, for the music involved, is quite close to the RIAA specification.

VIENNE—City of My Dreams

Columbia WL 156

The technique of dubbing the sounds of a city into a recording of its music is hardly a new one yet the Austrian crew involved in this project has turned in a fresh-sounding portrait of Vienna. Most of us have encountered recordings of this type in which the sound effects were burdened with a distorted content greater than that of the studio-recorded orchestra. Here the problem is licked in a very simple way. The extraneous sounds are kept at true background level while the orchestral arrangements are used for maximum effect in pinpointing the lighter side of the Viennese musical scene. Among the sources of local color are the city's cabarets, bars, and wine gardens. Even the leading amusement park has been pressed into service for some of the background atmosphere. The local orchestra under the direction of Karl Gries has the relaxed freedom of authentic Viennese music making.

(Continued on page 67)
PROTECT YOUR RECORD COLLECTION WITH AUTO-POISE

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Record scratch is a thing of the past with REK-O-KUT Auto-Poise—the first self-powered automatic tonearm. For the first time, the flawless performance of the single-play turntable and independent tonearm is combined with convenient push-button operation. Auto-Poise, the first automatic self-powered independent tonearm, pays for itself by protecting your record collection and high-compliance cartridge. You get unequalled record protection fully automatic operation single-play turntable and independent tonearm performance. Ask for a demonstration of Auto-Poise at your high fidelity dealer. Write for free literature today.

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Audio • March, 1962
I haven't said a word about FM-stereo for almost nine months. Not since last spring, when the new system was first approved. (I won't count a passing reference to FM-stereo's "phase-9" characteristics, a few lines back.) Good enough reason. It takes awhile for this kind of pudding to cook. And the proof's in the eating, remember, the listening. It wasn't until almost the end of last year, that very late one night, Miss Sarah Vaughan suddenly belted out a number of one of my stereo loudspeakers, where her accompaniment dribbled forth out of the other. Stereo! Well, maybe it wasn't stereo but there sure was plenty of separation. I tried my balance control, from one channel all the way over to the other; yes, definitely, this was it. The real ping-pong McCoy. There was Miss Vaughan all along slightly larger than life and much closer, stereo but there sure was plenty of separation. My musical ears were not impressed. But if La Vaughan can do it, so can Beethoven and Mozart. I mean, maybe, Leonard Bernstein and Leopold Stokowski.

If you've got separation, you've got everything. (Well, almost everything.)

A Slight Delay . . .

Yes, I'm aware that thousands of ardent audiofan sat up most of one night, back there last June, intent upon hearing the first ten seconds of genuine stereo-on-the-air. (I am aware that the editorial staff of our magazine was numbered among the wakeful hopefuls, too.) Not me—though I did ride on the very first train on the new Sixth Avenue subway in N.Y.C., back in the thirties. (Just to show you I can get in a "first" when I feel like it.) I went to bed early, and figured I'd look into FM stereo in a couple of months or so, maybe by late August. I was much too optimistic, of course. Shouldn't have given it a thought until after Christmas.

New keep carefully in mind that I am speaking here about laymen's stereo (multiplex), as per title. Needless to say, during these six months or so the inner audio community was positively soothed with FM stereo activity, building its collective neck in a hundred ways over the frightening task of living up to advance publicity, getting real audible, workable FM stereo out where it belongs, in the living room. This was a "phase 2" with a vengeance, as almost any participant will admit, I think, and the problems were genuine all along the way. As a semi-insider, I heard rumors and talk all the time, from every side—not merely in the building of home stereo tuners but also among people who were having their minor disasters, and even from the program departments, who sometimes found that a large proportion of available stereo disc material wouldn't work on FM-stereo broadcast—complex and unforeseen technical allergies, so to speak, phase cancellations, and the like. A frantic time was had even here, auditioning huge quantities of records in the search for something the System would tolerate; and that, of course, was merely one minor area of problems. There were plenty more, most of which belong in the technical sections of this magazine and which I can do no more than acknowledge as existing. Even such minor annoyances as that truly audio beauty tone that shows up with some tape recorders. Bias, tangling with the multiplex.

So I went up where it belongs, all along slightly larger than life and much closer, stereo but there sure was plenty of separation. Some stereo ready to hear. They did, and I went to bed early, and figured I'd look into FM stereo in a couple of months or so, maybe by late August. I was much too optimistic, of course. Shouldn't have given it a thought until after Christmas. But this was last June, end of the thirties. (Just to show you I can get in a "first" when I feel like it.) I was too busy right then with a large program of material that the System would tolerate, and that, of course, was merely one minor area of problems. There were plenty more, most of which belong in the technical sections of this magazine and which I can do no more than acknowledge as existing. Even such minor annoyances as that truly audio beauty tone that shows up with some tape recorders. Bias, tangling with the multiplex.

A conscientious audio designer is more than a too-hasty launching of imperfect equipment, half-baked. There will always be serious problems in this sort of development that simply cannot be foreseen ahead of time.

What was the layman's likely first move, towards stereo on the air? Well, I figured first I'd like to try a conversion. After all, if I really believed that the System was as perfectly designed as, say, the telephone, or the telegraph, or the automobile, or the phonograph, I'd have just given it a thought until after Christmas. But this was last June, end of the thirties. (Just to show you I can get in a "first" when I feel like it.) I was too busy right then with a large program of material that the System would tolerate, and that, of course, was merely one minor area of problems. There were plenty more, most of which belong in the technical sections of this magazine and which I can do no more than acknowledge as existing. Even such minor annoyances as that truly audio beauty tone that shows up with some tape recorders. Bias, tangling with the multiplex.

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StAYS in the Equipment Profile write-up of this very conversion unit, "at long last." Citation MA. The editors erected out the wait, too, and don't think they didn't expect it, just as I did. A conscientious audio designer is more than a too-hasty launching of imperfect equipment, half-baked. There will always be serious problems in this sort of development that simply cannot be foreseen ahead of time.

So, as of now, I am still looking forward with utter equanimity to a continued slight delay in receiving the multiplex tuner, in exchange for the Citation III stereo, the more confident I am the better, of the eventual delay. As I say, 1 was understanding last August. (It was really on the ball this last year. That company somehow got its FM business out in the open, and its design of the multiplex tuner all in a single package, way in relatively short order and, in no time at all (just a few months) came out with workable, buyable, practical stereo equipment. I didn't try my balance control, from one channel all along slightly larger than life and much closer, stereo but there sure was plenty of separation.

Pilot's Separation

Miss Vaughan, you see, came to me courtesy of another company, Pilot. (It was another company. Since then, I discover to my astonishment, Pilot has been bought by a corporation that also owns Harman-Kardon, maker of the Citation line.) Pilot was really on the ball this last year. That company somehow got its FM business out in the open, and its design of the multiplex tuner all in a single package, way in relatively short order and, in no time at all (just a few months) came out with workable, buyable, practical stereo equipment. I didn't try my balance control, from one channel all along slightly larger than life and much closer, stereo but there sure was plenty of separation.

Since we've already printed an extensive Equipment Report on this model (Audio, January 1962, page 44), I'll concentrate on the actual experience I have had with this very honestly designed piece of equipment. It has already taught me much, both pro and con, about the larger picture in present-time FM stereo. I don't even know both at my city location, in the heart of Manhattan,
**FM MULTIPLEX**

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4-TRACK STEREO TAPE DECK RP100

Completely assembled, wired and tested. **$399.95**

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A top quality stereo tape recorder permits you to build a stereo tape library of your favorite music at low cost. As your musical interests change, you may record the new music that interests you at no additional cost.

Perfected 4-track stereo mono recording, 4 & 2 track playback. True high fidelity transistor electronics, individual for record & playback, plus separate record & playback heads permitting off-the-tape monitor. 2 recording level meters, mixing, mic & level controls, switched sound-on-sound recording. Electrodymanically braked supply & take-up reel motors; hysteresis synchronized capstan motor. Individual sole-purpose pads. No slurring or tape bounce problems. Segmented tape guidance & sweep loading - no pinions for pinch-roller & tape lifters. All-electric, interlocked push-button transport control & sound-on-sound recording. Electrodynamically braked supply & take-up reel motors; hysteresis synchronized capstan motor. Individual sole-purpose pads. No slurring or tape bounce problems. Segmented tape guidance & sweep loading - no pinions for pinch-roller & tape lifters. All-electric, interlocked push-button transport control.

**NEW FM MULTIPLEX AUTODAPTOR MX99**

Kit **$39.95**

Wired **$64.95**

Cover optional $2.75

An original EICO contribution to the art of FM Multiplex reception.

**FM-AM STEREO TUNER ST96**

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Includes Metal Cover and FET

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STS6: FM and AM stereo tuners on one compact chassis. Easy-to-assemble; prewired, pre-aligned RF and IF stages for AM and FM. Exclusive precision prewired EYETRONIC® tuning on both AM and FM.


AM TUNER: Switched "wide" and "narrow" bandpass. High-Q filter eliminates 10 kc whistle. Sensitivity: 3uv for 10V output at 20db S/N ratio. Frequency Response: 20-9,000 cps ("wide"), 20-4,500 cps ("narrow").

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AM TUNER: Switched "wide" and "narrow" bandpass. High-Q filter eliminates 10 kc whistle. Sensitivity: 3uv for 10V output at 20db S/N ratio. Frequency Response: 20-9,000 cps ("wide"), 20-4,500 cps ("narrow").

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**AUDIO • MARCH, 1962**
Preserve the Genius of the Masters with the

Natural Sound of

RE Tandberg

and in the country, a hundred miles away, with fringe and static at its most deadly, I can sum up the 602M major qualities in just two observations.

First, it has the essential quality for stereo reception, the absolute necessity of the period: SEPARATION. La Vaughn sold me not only on Pilot but on stereo broadcasting, all in the space of a few moments! For Pilot a real debt of thanks for bringing me then, after so many months of doubt, the first absolutely concrete evidence that stereo broadcasting does, truly, honestly, without the slightest doubt, produce real stereo.

Secondly, that much-discussed 17-db loss in effective sensitivity as between stereo reception and mono reception of the same signal is a stark reality. The Pilot 602M in its role as a moderate-cost but carefully designed over-all performer is not particularly sensitive. Sensitivity is only one of many desirables, remember, and not always needed, either.

In my country home I found that this tuner behaved moderately and nicely on FM mono, receiving dozens of distant stations with complete limiting and perfect silence, picking up the weak ones with varying degrees of steady hiss and/or swish-swish (interference from planes), exactly as might be expected. My ultimate-sensitivity test, my own weak signal from New York's WNYC 100 miles away, was marginally audible on the Pilot sometimes quite clear, at other times fading to nothing. That's nothing new, you may be sure! It happens with most tuners.

However, on the other hand, the Pilot behaved quite unexpectedly, the thin margin of usable reception I had on hand at this critical distant range was drastically reduced. The hiss became a giant roar, just as big as the plane, an interminable noise increase in a heavy bass "rumble." Net result was that though I could pick up New York stereo at 100 miles via Pilot, I could not eliminate the background noise to the point where the reception was practical. (I could hear the stereo separation—definitely and reassuringly. Remember that.)

WTFM, our New York all-weather 24-hour stereo station, was always audible but was not quite strong enough to limit the stereo noise background. WQXR's Boston Symphony "live" broadcast (via tape) was considerably weaker, some Saturday night. I could just about make out the music, and confirm that the stereo sound still was there. Five minutes of the jet roar was all I could take of that. And nobody else around the East seemed to provide any stereo for me to check with. When I tried stereo hunting, right across the band. Not a thing. It's amazing, I'm sorry to say, how little stereo there is on the air, even now.

But you can't make meat out of bones—this is only by radio broadcast. Let's be realistic. 24 hours a day is an awful lot of time to fill when the hours, days, weeks, months insist on mounting relentlessly and without a limit. So let's not get into your stereo chicanery too fast. There aren't very many of them, yet.

Let's be realistic, too, about Pilot's 602M and a good many other stereo tuners that may fit in the same moderate and popular intermediate category. I said the Pilot was "honest." I mean just that. If I am right, Pilot could have reduced some of this huge roar on weak stereo signals by compromising the stereo itself. (Anybody can do it, of course, for reasons of price, to reduce the roar to a hiss; but that also cuts out the bass in the music.) I'm not enough of a technician to know at this time what potential weaknesses in design parameters here, but I am confident that Pilot's insistence on real, 100 per cent stereo separation even at the possible expense of some extra noise as compared with standard (mono) FM, is both an honest approach and a highly valuable one. After all, it plays, all day long, in many areas—the same basic facts that want the most of it there is. More sensitivity—without stereo compromise—would help, though. Let's not underestimate this need for extra sensitivity in multiple stereo reception. It is a drastic need, for all weakish reception and in all fringe areas. On the other hand, in most urban or near-urban areas—which means the entire space of a few miles around 30 or 40 miles of a strong station—the sensitivity factor is not so important. There is plenty of reserve and more, in any reputable component tuner. Then I wouldn't say as much for some of the weak-sister FM receivers of the table-model sort. I've had occasion to run into.

(My Connecticut neighbor has an FM mono table model, built with-in aerial, around 200 yards from my house. I can tune some 60 FM stations (mono) via any名列前茅 tuner well-placed in my rotating house-top antenna. Neighbor M. can get exactly one local station, rather faintly. Fortunately, it's a "good music" station and his wife loves it. The thing just plays, all day long, in that tiny attic and in the city corner to get the best reception. Turn it halfway around and there's no FM at all.)

Moral: Beware of fringe reception if you buy stereo; get the most sensitive tuner you can possibly pay for. But if you are in a normal location with good, strong signals available on any channel—due to the presence of some good dipole inside the house (or if you have a better antenna outdoors or in the attic that gives the equivalent), you can buy a Pilot or similar tuner without the complete background silence on FM broadcasts—and via the Pilot I can guarantee, first-hand, that you will hear stereo.

I note that the same basic Pilot circuit is available in other forms, including the conversation unit, which if I am right should "work" with virtually any mono tuner.

I note also that current issues of Audio are so full of stereo multiplex tuner ads that I am left gaping with astonishment, and hope that you all out there understand the beginning of that. And, that I chose Pilot for preliminary trial last fall because the Pilot company did get into this brute practical production (as opposed to advertising) very quickly and, last autumn, was clearly one of the few companies out in the field. Things have changed since then—now there are rivals on every hand, as you may see by looking about you on these pages. I trust that my early experience with your usual readers, whatever brand of tuner you try out for yourself, as of now.

Model 68—6 Speed 4 Track Stereo Record/Playback Tape Deck

The remarkable features of this superb unit speak for themselves—records 4 tracks; plays back 2 and 4 track stereo and mono; records/plays back FM Multiplex Stereostation with magnificent clarity, even at 3/4 ips. Permits sound-on-sound, track adding, direct monitor from source or tape; has push button control, three separate Tandberg engineered precision laminated heads, hysteresis synchronous motor, installs into Hi-Fi system. Price $49. Remote control "F" 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 unchanged for clear, crisp, natural sound!
Highest Output For Best Quality
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Model HF-90M

1. Silicon diode with high regulating capability is used in rectifier circuit to produce a powerful output of 80 watts without distortion. This unit is so compact that it may be conveniently installed or moved around.

2. One of the most distinguished features of the HF-90M is superb low-frequency characteristics which are rarely found in other amplifiers. The distortion-free output (distortion reduced to 1%) is 75W at 30 cps and 50W at 20 cps.

3. This amplifier uses a large output transformer with a core of 3 1/8" x 4 1/8" x 1 3/8", the same in size with that of a power source transformer. Such a large output transformer usually has rather poor high-frequency characteristics and it is difficult to apply negative feedback. In order to overcome such defects, this amplifier has specially designed tertiary coil so that a great deal of stabilized negative feedback may be applied.

The HF-90M is the best professional type basic amplifier featuring exceedingly powerful output, superb tone quality, highly stabilized performance and compact size.

+ Model HF-90MH provided with a terminal for high impedance output (200 ohm) and an output terminal for monitoring is scheduled to be placed on the market together with Model HF-90M.

Specifications:
- Electrolyte tubes: 3 tubes, 2 silicon diodes, Selenium rectifier
- Circuit system: 6C7PP Fixed bias
- Gain: 0.5V, 60V at 1kHz
- 5 N enters: More than 766k
- Output terminals: 4, 8, 16 ohm
- Maximum output: 100W
- Distortion limit: Output: 60W (less than 1% distortion at 1kHz)
- Frequency characteristics: 30 c/s -> 20Kc ± 6db
- Non-linearity: Less than 1.5% at the lowest level
- Voltage: 100, 117V (monophonic)
- Power consumption: 300W
- Dimensions: 14.7/16"x14.7/16"x1/2" (7.1/16"x7.1/16"x3/16")
- Weight: 33.07 lbs

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EDITOR'S REVIEW

PERFORMANCE, SIR!

IN THE PAST FEW YEARS high-fidelity components have achieved quality levels which are truly remarkable—for instance, we noticed in the process of putting together our Test Equipment Roundup in the January issue that the residual distortion of some laboratory-type test instruments actually is as great as the total distortion of several available components. Tube components, that is!

Now, however, there is much talk about the inevitable and imminent transistorization of components. According to the conversations we have heard the changeover is supposed to occur within the next three or four years. Well, perhaps these predictions are correct but we can't help wondering, in view of the unusually high quality of existing tube equipment, why it is necessary to abandon known excellence for the "wee electronic wonders?" Even more to the point, will transistorized equipment perform better than, or as well as, existing components in the equivalent category? It seems to us that unless the latter question is answered affirmatively, transistorization will be a step backwards.

We do not deny the important virtues of solid-state devices; smaller size, less weight, and reduced heat. But these qualities must necessarily take a back seat to performance in high-quality components.

Don't misunderstand, we are neither saying that transistorized components are necessarily worse than tube components nor that conversion to transistors is undesirable; what we are saying is that the decision to convert should be based primarily on performance. And reliability. And serviceability.

STANDARDS

Recently we visited a local audio emporium to purchase a resistor or something, and overheard a conversation which disturbed us somewhat. In effect we heard a salesman saying that the IHFM (Institute of High Fidelity Manufacturers) rating system for amplifiers (music power) was not as valid as the rms rating. Whether or not he is right about amplifier ratings (we have commented upon this in the past), and whether or not he was trying sincerely to help a customer, we are inclined to believe that the over-all effect is harmful.

First of all, the basis for an industry-wide standard is that it be accepted and used by the entire industry. Because such standards exist, the consumer can be confident that a 20-watt amplifier will not change in power from store to store. The manufacturer can be confident too.

Now, what if the standard is inadequate in that it does not truly standardize the qualities it purports to make standard? It seems to us that the proper procedure would be to fight hard to change the standard—not tear down the system of standards! Indeed, it is vitally important for the consumer to insist on the use of these standards—they are one of the best yardsticks available to him.

As an interesting footnote, recently the Magnetic Recording Industry Association set up an eleven-man Standards Committee in order to assure consistent high standards in the tape industry. Another step in the right direction.

MEMORABILIA

Fifteen years ago, come May, AUDIO (then called AUDIO ENGINEERING) started a course of events which has inexorably led to the magazine (and industry) as we know it today. In the course of these fifteen years, many exciting events have occurred and AUDIO readers have participated in them. In our May issue we will devote a considerable amount of space and effort to retelling those eventful years. In order to make this as meaningful and interesting as possible, we invite each of you to participate—to send us photographs or other documents which would shed light on the growth of the high-fidelity field. (We promise to use them gently and return them quickly.) Naturally the most useful photographs would show some of the early equipment as well as the important events.

In addition, we invite you to gaze into your crystal ball and predict what you think the next fifteen years holds in store for the high-fidelity field. Do not feel restricted, make your predictions as technical or non-technical as you wish or are capable of. We will tabulate all the predictions and report the results in May. Fifteen years from May it will make interesting reading for any of us still around.
PICKERING & COMPANY INC. offers the stereo fluxvalve pickup in the following models: the Calibration Standard 381, the Collector's Series 380, the Pro-Standard Mark II and the Stereo 90. Priced from $16.50 to $60.00, available at audio specialists everywhere.

"FOR THOSE WHO CAN HEAR THE DIFFERENCE"

Pickering and Company—Plainview, Long Island, New York
Bell Laboratories engineers have applied a method of transmitting telephone conversations which uses a series of ON-OFF pulses rather than the continuous electrical signals generally used since the time of Alexander Graham Bell's first famous message.

The method is called Pulse Code Modulation. With PCM the telephone caller's voice is sampled every 1/8000th second. Each sample is then encoded into a series of ON or OFF pulses, and these pulse groups are sent over the regular telephone line. Spaced periodically along the line are repeaters which clean up and amplify the pulses. At the receiving end the pulse groups are decoded and the caller's voice is reconstructed.

Since the pulses are of very short duration, it is possible to interlace many different voice messages and send them all over one line. For example, in a PCM system now operating between Newark and Passaic, N. J., a single pair of wires carries as many as 24 one-way voice signals.

Other systems for carrying more than one voice signal over a single telephone line have been developed and are in widespread use. PCM, however, provides special advantages, for example, in cable circuits connecting telephone offices in a congested metropolitan area.

PCM in its present practical form for cable circuits has been made feasible by Bell Laboratories' invention and development of the transistor, the key element necessary for a small economical system.

Currently, PCM systems carrying much larger bundles of communication channels are under study at Bell Laboratories. The goal as always is the improvement of Bell System communication services.
A High-Quality Stereophonic Mixer

ROBERT GERBRACHT

The avid tape recordist can improve his recordings by use of a mixer. Here is one that will mix four stereo channels (two each high and low level) or eight mono.

For a wide variety of reasons it is sometimes desirable to employ several input signals simultaneously. Such instances occur most often during recording—adding spoken commentary to recorded music, sound-on-sound techniques, and other special effects. When more than one input source is employed it is necessary to supply means of switching from one to another, controlling the amplitude of the signals, fading them in and out, and mixing them as desired. It is the purpose of the mixer to perform these operations smoothly and without noticeable discontinuities in the output.

Mixers come in all sizes and forms depending upon their projected use. They may be divided into classes defined by the inputs: high or low impedance, constant or variable impedance, high or low amplitude. Further diversification arises according to whether or not amplification is provided during the mixing process. By and large equalization is applied before the mixing stages, but even this function may be performed simultaneously with the mixing.

The dividing line between high and low impedances for the purposes of this article will be taken as some few kilohms. Obviously the dividing line is somewhat vague—in practice, however, things are much improved, for there is a gap in the range of impedances of commercial devices between about 600 ohms to perhaps 10,000 ohms. A similar situation exists in the case of signal levels—the dividing line may be taken as perhaps 50 mv, although 20 mv would be a large "low-level" signal, and perhaps .1 volt is closer to usual "high-level" signals.

It is up to the mixer to accommodate the wide latitude of impedances and output levels and to function properly throughout as broad a range as possible.

Design Considerations

The most common signal sources are: high-level high-impedance (tuner, preamplifier output, ceramic cartridges, and so on); low-level high-impedance (magnetic cartridges, some microphones); and low-level low-impedance (other microphones). High-level low-impedance sources are rarely found outside of the usual 600-ohm studio line. For convenience and simplicity we will consider only high-impedance sources. Now the signals to be mixed must be of the same order of magnitude; hence low-input signals must be amplified to the level of the high-level inputs before mixing. Since preamplification is necessary at any rate, the output then being high impedance, the choice of a high input impedance mixer in no way limits the versatility of the device. It is only necessary to provide a suitable means for amplifying the low-level signals by a factor of perhaps 40–60 db, taking pains that the input impedance of the preamplifier matches that of the signal source.

Magnetic cartridges require equalization and should be terminated in a fixed impedance (usually 47,000 ohms). Without further discussion it is assumed that the signal from such a cartridge will be amplified and equalized in the usual fashion and presented to the mixer as the (high level) output from some preamplifier. Microphones require no equalization—preamps suitable for high impedance microphones are included in the mixer described in this article. Although low-impedance microphones are often superior to their higher impedance counterparts, the microphone may be terminated in a suitable transformer and the output changed to high impedance with little trouble and moderate expense. Alternately, the output may be sent through a transistor circuit in the
contact the signal must be on the order of at least 100 mv, i.e. a high-level signal. Hence all low-level signals must be amplified before the attenuator. This is no drawback, however, since amplification of low-level signals is necessary before mixing anyway.

Probably the most popular and common type of multi-input mixer-amplifier is the common-plate circuit shown in Fig. 2. This circuit has the advantage of complete isolation between inputs—no amount of change in the levels of any input has any effect on that of any other, an important requirement for any mixer. On the other hand, one tube section is required for each input. An alternate design, Fig. 3, utilizes plate-grounded-base configuration which has the properties of low-input impedance and high-output impedance. From here it may proceed to the high-input impedance preamplifiers. Finally, the output of the mixer may be sent to a cathode follower, thus removing any need for constant output impedance. These considerations simplify the design of the mixing stage considerably.

For a mixer to be a mixer it must have at least two signals to mix—each signal may be high level or low level. This dictates at least four inputs. The common-plate configuration for n inputs.

Theory of Operation

Figure 4 shows the equivalent circuit of the common-plate configuration for n inputs. \( R_L \) is the common-plate load while \( r_p \) and \( \mu \) are the tubes' plate resistance and amplification factor, respectively (tubes assumed identical).

Here \( e_o \) is the signal output while \( e_i \) is the \( i \)th input signal. Cathode resistors are eliminated for simplicity. Then

\[
\mu e_i + i_{p} r_p = \mu e_2 + i_{p} r_p = \ldots = -i_{p} R_L
\]

where \( i_p = e_1 + e_2 + \ldots + e_n \). Hence

\[
\mu (e_1 + e_2 + \ldots + e_n) + r_p (e_1 + e_2 + \ldots + e_n) = -i_{p} R_L
\]

so that

\[
\mu (e_1 + e_2 + \ldots + e_n) = -i_{p} (r_p + n R_L)
\]

But

\[
e_o = \frac{-n R_L}{r_p + n R_L} (e_1 + e_2 + \ldots + e_n)
\]

Eq. (1)

From this it is seen that all signals are mixed evenly and also that any given input is amplified by a factor

\[
A = -\frac{n R_L}{(r_p + n R_L)}
\]

Eq. (2)

This compares with the usual expression for a triode amplifier gain \( A = -\frac{r_p}{(r_p + R_L)} \) so that the gain is altered by the factor \( (r_p + n R_L)/(r_p + n R_L) \). For triodes this often approximates \( 1/n \) indicating that amplification is markedly lessened in the mixer. Moreover, due to the shunting of the load resistor by the plate resistance of the various tubes it is evident that the output voltage for some given amount of distortion is reduced in the ratio \( r_p/(r_p + (n-1)R_L) \) from that of the single amplifying stage. But as the output from the mixer need be only a few volts this limitation is not serious.

Circuit Details

Figure 5 shows a block diagram of the mixer. Low-level signals are amplified 43.5 db in a cascode preamplifier. The two low-level inputs and the two high-level inputs are then mixed in relative amounts depending on the settings of the level controls. Over-all gain for the two channels is adjusted by a ganged volume control. A simple switch changes the dual 4-input mixer into a single 8-input mixer with a variable resistor serving as a separation control. At this point information is taken from each channel and delivered to an amplifier stage and then to a VU meter which
serves as a visual monitor. A cathode follower completes the circuit.

Figure 6 presents the schematic diagram of the mixer. Only one channel is indicated, the other being identical. The low-level preamp is an almost standard cascode amplifier followed by a voltage amplifier and d.c.-coupled cathode follower. The function of the 120,000-ohm cascode plate resistor has been described by Shirer. A gain of 150 is delivered by the two tubes. The cascode tubes \( V_I \) and \( V_2 \) are 12AY7's, a premium low-noise, low-microphonic tube especially designed for low-level amplification, while the cascode circuit is used for its low-noise characteristics. One per cent deposited film precision resistors are used throughout the preamps to ensure low noise. Well filtered d.c. is applied to the filament of all preamp tubes operating at low-signal levels. Regulated B+ is used throughout to provide exceptional stability and low-hum levels. Large amounts of feedback are applied in the preamps, including the unbypassed cathode resistors, cathode to cathode feedback from \( V_{eb} \) to \( V_Ta \), and, indeed, the basic design of the cascode circuit itself. The output from the preamplifier is flat within 1 db from below 5 cps to 175,000 cps. The cathode resistor of the cathode follower output from the preamplifier is a 100,000-ohm pot and serves as the level control. A spot switch grounds the output when no signal is present.

The high-level inputs go directly to similar 100,000-ohm pots and on-off switches, and then directly to the mixer tubes.

The mixer circuits are identical for high- and low-level signals with the exception of the grid resistors and coupling capacitors of the low-level stages. Two 12AX7's are common-plate coupled. For these tubes \( \mu = 100, r_p = 80,000 \) ohms, so according to Eq. (2)

\[
A = \frac{100 \times 27}{50 + 4 \times 27} = 14.4
\]

Unbypassed cathode resistors supply 5.2 db of inverse feedback and the resultant gain is 8.

The mixer output is coupled through the 5 \( \mu F \) capacitor to the 100,000-ohm master gain control and the grid of the cathode follower. The latter has a gain of 0.9 which serves to make the over-all gain for low-level signals exactly 1000, and 7 for the high-level pick-ups. Two partially isolated outputs are supplied so that, for example, an audio amplifier and tape recorder may receive the signal with output being available at one output jack even if the other is grounded, which sometimes is done in equipment when the input is not being used. The output impedance is approximately 10,300 ohms.

![Schematic of the mixer (only one channel shown, the other is identical).](image)

Fig. 6. Schematic of the mixer (only one channel shown, the other is identical).
which permits the use of an output cable with a shunt capacitance of up to 750 pf before the highest audio frequencies are noticeably attenuated. This corresponds to an output cable length of approximately 30 feet.

When the mixer is employed in the 8-input configuration the over-all gain is reduced by a factor of 2 if the separation control is completely shorted. When this control is fully open the signal injected into the alternate channel is about 15 db below that of the original channel.

Input to the meter circuit is from three points. Switches on the front panel send the signal on any or all of the mixer grids through the meter, or the total output of the mixer may be monitored. In the latter position a voltage divider consisting of the 120,000 and 820,000-ohm resistors takes account of the gain of the mixer stage and eliminates the necessity of changing the meter sensitivity switch. A third position is supplied for any external signal, such as that from an audio preamplifier. The mixer requires a step-type attenuator, cathode follower to the meter. The resistors of the attenuators were hand picked from a box of standard 10 per cent resistors to ensure their proper values. For example, the 550,000-ohm resistor is actually a 560,000-ohm resistor with somewhat low resistance.

The power supply for such a device must be carefully designed. Hum cannot be tolerated with such low-level signals. Direct current on the filament supply is essential to low-hum operation—regulation of the filament supply is helpful, but not absolutely necessary. On the other hand, regulation of plate voltages is necessary for long-term over-all operational stability. It goes without saying that hum on the B+ line must be insignificant. The mixer requires a +225 volt regulated supply at about 65 ma, and filament voltages. In the actual construction of the mixer a slightly modified commercial power supply was used with regulated outputs of +225, +150, and -170 volts. The negative supply at 150 ma was used to supply regulated filament voltages with a series string arrangement to all tubes except those in the meter circuits. It was desirable to keep the transformer rating low in order to avoid hum. The 12AX7's are stacked toward the ground side of the line—otherwise the filament-to-cathode voltage ratings may be exceeded. The 12AX7's will tolerate 200 volts between filament and cathode and thus may safely be placed at the upper side of the filament supply.

A considerably simplified power supply circuit is shown in Fig. 7. Here an isolation transformer, T1, supplies 117 volts of a.c. at an easy 150 ma. This is rectified in a typical full-wave bridge and filtered. This supply sends well-filtered d.c. to the eight preamp tubes operating at low-signal levels. The other tubes and the various pilot lamps are powered from the usual 6.3 volt winding of transformer Tp. Plate voltage is also obtained from this transformer. After rectification and preliminary filtering the output passes through a standard series voltage regulator. The series regulation tubes V16 and V17 are each rated at 35 ma. The error signal is applied to the grid of V17, a high gain amplifier, through the sliding arm of the 20,000-ohm pot which permits accurate adjustment to +225 volts. A premium 5651 gas VR tube provides a stable reference voltage and completes the tube complement of the supply.

Construction Details

Two views of the mixer are shown in Figs. 8 and 9. The construction of the mixer employs a few techniques worthy of mention. Careful attention was given to shielding of the low-level stages—the power supply is isolated by shields across the width of the chassis, top and bottom, and shielded cables are used whenever long signal leads are required.
Operation and Performance

The rated output of the mixer is taken to be 1 volt. This is sufficient for nearly all purposes—if not, the mixer will deliver outputs up to six volts without appreciable distortion. The sensitivity for choring the eight toggle switches. Decals were used to complete these, and the brass pieces then covered with lacquer. A polished brass bar divides the panel horizontally, with brass knobs purchased form a well-known component manufacturer completing the front panel design. The finished chassis is slid in from the rear and bolted to the cabinet bottom. The result is shown in Fig. 1.

Rated output using the low-level inputs is then 1 mv—for the high-level inputs the sensitivity is 150 mv. The signal-to-noise ratio for the low-level inputs is 54 db, corresponding to an effective noise input of 2 mv. Hum is well below this thermal and tube noise. At the high-level inputs the signal-to-noise ratio is 85 db. These figures all correspond to the stereo, 4-input configuration. When the mixer is used as a single-channel 8-input mixer the output is reduced by a factor of two. Thus the sensitivity of the mixer changes to 2 mv or 300 mv, and the signal-to-noise ratio improves by the corresponding 6 db.

The frequency response of the mixer is shown in Fig. 10. It is evident that the output is essentially flat up to and beyond 100,000 cps. and to below 5 cps. This result is independent of the input, for the low-level stages have flat response well beyond these limits.

At this point it may be proper to consider the matter of distortion. Figures on distortion—harmonic and intermodulation—are difficult to come by. With such low power applications distortion in a properly designed amplifier will not exceed a few tenths of a per cent, even at the extreme ends of the audio spectrum. Graphs of harmonic distortion vs. frequency are rather uninteresting—they generally consist of a horizontal straight line. Even the ordinate of this line is indeterminate if high quality equipment is not available, capable of measuring distortion levels on the order of .1—2 per cent. This is the situation in this case. The only remarks on distortion consist in the fact that the distortion is certainly less than .3 per cent throughout the audio range and at outputs of up to six volts.

Crosstalk is an important characteristic of a mixer, for good isolation must be achieved between various inputs and between the two channels. At 1000 cps. feedthrough is down 45 db between inputs of each channel, while between the two stereo channels the crosstalk is 55 db down. At 10,000 cps. the above figures change to 35 db and 45 db respectively. This is sufficiently low to be ignored.

The mixer described above is a flexible, unit offering complete control simultaneously over a large number of inputs. The mixer may be used for many purposes, of course, but its primary utility arises during tape recording. For the avid recordist some type of mixer is practically mandatory and this unit should fulfill the wishes of the most exacting.

The parts listed below are for one channel only. For stereo the number must

(Continued on page 53)
The Frequency-Response Specification

MANNIE HOROWITZ

Frequency response is one of the most commonly quoted statistics of a high-quality amplifier. Here's how it is obtained and measured.

It is most likely that the first characteristic recognized by the audiophiles in relation to an audio amplifier is frequency response—which can be defined as the relative gain of the unit over a range of frequencies. The significance of this yardstick has not waned with time, but other amplifier characteristics have assumed a place of equal importance.

The importance of a flat frequency characteristic requires little discussion. It is quite obvious that for accurate sound reproduction, all frequencies should be given "equal opportunity." Any frequency presented to the input of an amplifier should be amplified the same amount as any other frequency simultaneously presented at the same input. There are several important exceptions to this ideal.

First, it must be realized that the output from an equalized phonograph or tapehead preamplifier is not uniform: records and tapes are recorded to adhere to a specific curve wherein some frequencies are favored. During playback, the amplifier must compensate for these frequencies in order to provide an overall flat response from the source (phonograph record or prerecorded tape), the transducer, and the amplifier. We will discuss the measurements of frequency response from the tuner input of the preamplifier through the power output section. The characteristic must be reasonably flat when only these sections are considered.

A second consideration is the frequency range desired from the amplifier in question. While many units will have a flat response to several octaves on either side of the audio spectrum (assumed here to be 20 cps to 20,000 cps), some amplifiers are designed for limited bandwidth in the interest of increased stability and reduced noise. The latter factor is especially true in transistorized units, where bandwidth limitations are required to keep noise measurements comparable with actual audible noise reproduction.

Frequency response is usually measured in dB although it can also be measured in terms of voltage or power. In the latter cases, the numbers would become astronomical. A brief review of dB is thus in order here.

The Decibel

The decibel is defined by the simple equation:

\[ db = 10 \log_{10} \frac{P_o}{P_i} \quad \text{Eq. (1)} \]

where \( P_o \) = output power from an amplifier and \( P_i \) is the input power. Putting this equation into another form, with the logarithmic base being 10, yields:

\[ db = 10 \log P_o - 10 \log P_i \quad \text{Eq. (2)} \]

During the frequency-response check, the voltages fed to the amplifier (\( V_i \)) must be maintained at an equal level for all frequencies. It is assumed that the input impedance (\( R_i \)) of the amplifier is not frequency sensitive. The latter condition can be assured by feeding the signal from a low-impedance source. The input power, \( P_i \), is thus constant at all frequencies because it is equal to \( V_i^2 / R_i \), two constants. The term \( 10 \log P_i \) in Eq. (2) can be replaced by a constant. We will call this constant \( K \).

In these tests, all measurements revolve about the \( 10 \log P_o \) term. In the actual test procedure, the \( K \) term is adjusted for a specific power reading at the output of an amplifier, for some frequency in the middle of the audio range. The central frequency is usually measured in dB although it can also be measured in terms of voltage or power. In the latter cases, the numbers would become astronomical. A brief review of dB is thus in order here.

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1000 cps or 400 cps. Ten times the log of the output power at all other frequencies is compared with this reading at 1000 or 400 cps. In the following discussion, 1000 cps is used as the reference frequency.

The equation for gain at 1000 cps is:
\[
\Delta \text{db} = 10 \log \frac{P_o (1000 \text{ cps})}{P_o (100 \text{ cps})} - K\]
Eq. (3)

For example, let us find the difference in gain (in db) at 100 and 1000 cps for 100 cps:
\[
\Delta \text{db} = 10 \log \frac{P_o (1000 \text{ cps})}{P_o (100 \text{ cps})} - K
\]
Eq. (4)

The db variation at 1000 cps from the reading at 1000 cps is found by subtracting Eq. (3) from Eq. (4), if the gain at 1000 cps is greater than the gain at 1000 cps or subtracting Eq. (4) from Eq. (3) if the gain at 1000 cps is greater than the gain at 1000 cps.

\[
\Delta \text{db} = 10 \log \frac{P_o (1000 \text{ cps})}{P_o (100 \text{ cps})} - K
\]
Eq. (5)

The output term drops out in the final equation. The resulting equation involves only the deviation of the log of the output power at 1000 cps from the log of the output power at 1000 cps.

Another way of expressing the difference in gain at 1000 cps and 1000 cps is:
\[
\Delta \text{db} = 10 \log \frac{P_o (1000 \text{ cps})}{P_o (100 \text{ cps})}
\]
Eq. (6)

The measuring circuit at the output of an amplifier takes the form shown in Fig. 1. The output power is developed across a load resistor, \(R_L\), and measured on a wide-frequency-range a.c. volt-meter. The power across the resistor is, of course, \(V_o^2/R_L\), where \(V_o\) is the output reading on the a.c. meter.

A straightforward procedure consists of measuring the output voltages at 100 and 1000 cps calculating the power at each frequency from \(V_o^2/R_L\) and substituting these into Eq. (6) to determine the db difference at the two frequencies.

Converting the equation to read directly in voltage would be much simpler, saving two calculations.

Consider the output power at 1000 cps to be equal to \(P_o (1000 \text{ cps}) = V_o^2 (1000 \text{ cps})/R_L\) and the output power at 1000 cps to be equal to \(P_o (100 \text{ cps}) = V_o^2 (100 \text{ cps})/R_L\). Substituting these into Eq. (5) yields:

\[
\Delta \text{db} = 10 \log \frac{V_o^2 (1000 \text{ cps})/R_L}{V_o^2 (100 \text{ cps})/R_L}
\]
\[
= 10 \log \frac{V_o (1000 \text{ cps})}{V_o (100 \text{ cps})}
\]
\[
= 20 \log \frac{V_o (1000 \text{ cps})}{V_o (100 \text{ cps})}
\]
Eq. (7)

Equation (7) can be used, assuming that \(R_L\) at 1000 cps is equal to \(R_L\) at 100 cps. This is generally true if the load resistor used in the test is noninductive. This formula does not hold true if a speaker load is used, for the load varies with frequency. All tests on amplifiers are made assuming a constant load at the output for all frequencies.

In Eq. (7), \(\Delta \text{db}\) is expressed as a ratio of two voltages. If one voltage is known, \(\Delta \text{db}\) can be calculated for any other voltage from the equation. These db values, representing different relative voltages, can be printed on the meter face, and read directly as in Fig. 2.

Reading db variation on this scale is obvious. Set the output for 0 db at 1000 cps on a convenient range. Read the deviation from this 0 db at any other frequency directly on the scale. If the voltage is on the next higher range, add \(10\) db to the original reading while, if you must switch to the next lower range, subtract 10 db. Every time you switch from the original reference range, you either add or subtract 10 db per range, depending on whether the output is higher or lower than the original.

If you use other than the 0 db as the reference voltage, all other readings must be referred to this new reference as if it were 0 db. Thus, if \(-2\) db were the reference reading at 1000 cps, a +4 db reading at 100 cps indicates a loss in gain of 2 db and a +2 db reading at 10,000 cps indicates an increase of 4 db.

Several factors may be observed when comparing the voltage and db scales. Doubling the voltage is the same as a 6 db increase while cutting the voltage in half is a 6 db decrease. A voltage factor of 10 is a change of 20 db. Doubling the doubled voltage indicates a second 6 db increase or a total of 12 db more than the original. Doubling the original voltage three times \((2 \times 2 \times 2)\) indicates 18 db increase over the original reading \((6 \text{ db} + 6 \text{ db} + 6 \text{ db})\). Similarly, 26 db \((30 \text{ db} + 6 \text{ db})\) indicates a voltage multiplication of 20; a multiplication by 10 is 20 db and a multiplication by 2 is 6 db, and \(2 \times 10 = 20\) or \(6 \text{ db} + 20\) db = 26 db. While numbers are multiplied, the db factors are added.

Another type of a.c. meter, extremely popular in the audio field, uses a sup-
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2. List the features (by code letter only) in their correct respective order.

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Note: All contest entries subject to Official Rules
pressed zero movement, as shown in Fig. 3. The scale does not start with zero and is essentially logarithmic in character. If this type of meter is used, each time the range is switched, it represents a change of 20 dB rather than 10 dB.

The Measuring Circuit

As indicated, the first step in measuring the relative gain or frequency response is to maintain a constant input voltage at all frequencies. As shown in Fig. 4, a meter is connected at the input to the amplifier to monitor the voltage fed from the signal generator. The output from the generator should be readjusted or checked each time the frequency is changed to maintain the input to the amplifier (as read on the input meter) constant at all frequencies.

Feed the signal from the oscillator to an unequalized input on the amplifier. This is usually marked TUNED OR AUXILIARY. Adjust all controls on the amplifier to get an optimum flat position. If a preamplifier is involved, the tone controls, loudness or contour controls, and the scratch and rumble filters are all set so that there is no compensation introduced. Turn all level controls to their maximum output position.

A level control can be considered as the resistive voltage divider shown in (A) of Fig. 5. A more exact representation of the level control as it is commonly used in the grid circuit of a vacuum tube is given in (B) of Fig. 5. The total capacity between the grid and cathode of the tube and is the sum of the grid-to-cathode capacity and (K + 1) multiplied by the grid-to-plate capacity (Miller effect). (K is the gain of the tube).

It can be shown from Fig. 5 that the high-frequency response is a function of the control setting. Assume the control to be set at a point so that the upper portion has a resistance \( R_1 \) and the lower portion has a resistance \( R_2 \). The admittance of the lower portion is:

\[
Y_2 = \frac{1}{X_2} = \frac{1}{R_2} + j \omega C_2 = \frac{1}{R_2} + j \omega C R_2
\]

so that the reactance becomes:

\[
X_2 = \frac{R_2}{1 + j \omega C R_2} \quad \text{Eq. (5)}
\]

The impedance of the upper portion is \( R_1 \). Treating this circuit as a voltage divider,

\[
\frac{\varepsilon_{\text{out}}}{\varepsilon_{\text{in}}} = \frac{R_1}{R_2} \frac{1 + j \omega C R_2}{1 + j \omega C R_2 + R_1} \quad \text{Eq. (9)}
\]

Divide the numerator and denominator in Eq. (9) by \( j \omega C R_2 \) to yield

\[
\frac{\varepsilon_{\text{out}}}{\varepsilon_{\text{in}}} = \frac{R_1}{R_2} \frac{1}{1 + j \omega C R_2 + R_1} \quad \text{Eq. (10)}
\]

Multiplying this equation by \( R_1 + R_2 / R_1 + R_2 + j \omega C R_2 \) results in

\[
\frac{\varepsilon_{\text{out}}}{\varepsilon_{\text{in}}} = \frac{R_1}{R_2} \frac{R_1 + R_2}{R_1 + R_2 + j \omega C R_2}
\]

The frequency at which the response is 3 dB from the center value is reached when the denominator takes the form \( 1 + j \omega R_2 \). \( \omega \) is the frequency in radians per second. The frequency response is thus a direct function of the relative values of resistors \( R_1 \) and \( R_2 \).

This situation is even more serious in stereo amplifiers. A potentiometer is usually placed in series with \( \varepsilon_{\text{in}} \) used for balance between the two channels. The frequency response must roll off at the upper end of the band when this configuration exists, for \( R_2 \) behaves as if it were part of \( R_1 \). In testing this type of amplifier, it is proper to set the level controls at maximum and the balance control for equal output from both channels. The response cannot be as flat at the upper end of the band as was the case with monophonic units. Because the rolloff is slow, and usually starts at about 10,000 cps, the effect will probably not be audible.

Continuing with the mechanical features of the test procedure, choose a convenient output impedance on the power amplifier and place the load resistor across it. The 16-ohm output terminals are usually used. Connect a 16-ohm, 25-watt, non-inductive resistor across these terminals. The power developed across this resistor is measured in terms of voltage on a wide range a.c. voltmeter placed across this resistor. (The readings may be converted to power if desired, using the \( V^2/R \) formula, where \( R = 16 \) in the example cited.) Place a scope across the load resistor. This last step does not result in actual data, but is required to monitor the wave-shape. An essentially sinusoidal output is required if the meter readings are to be significant.

The actual readings can now be made. Set the signal generator for a specific reading on the db meter at 1000 cps. Switch to all other significant frequencies (from 10 cps to 40,000 cps or more) and read the deviation from the original db setting.

It must be remembered that the measurement is for frequency response—not power response. The output must be so adjusted that the signal will not distort at any frequency under test. A 1-watt level is usually satisfactory. When the signal begins to distort, the reading is no longer valid. Start the test again at some lower output and repeat the measurements. Only then can you be certain that you are reading frequency response rather than power response.

The frequency response should be a smooth curve over the complete range. Any peaks are usually an indication of a tendency towards instability. Peaks (of about 2 db or more) within the audible range of 20 cps to 20,000 cps add undesired effects to the reproduced sound. The much disputed "presence peak" at about 2000 cps is said to add to the realism—but the purist will certainly disagree.

A square-wave test can provide a rough indication of the frequency response. Figure 6 illustrates how an amplifier may affect a square wave. Tilt and other variations of the waveform are possible and may be observed, but these have more significance in describing the phase shift rather than the frequency response.

The rise time of a square wave is a fairly accurate check on the upper limit of an amplifier's frequency response. A high-frequency square wave is illustrated in Fig. 7. This may be considered as the form assumed after having passed through an amplifier. It is actually a plot of output voltage against time.

The theoretical square wave has a zero

(Continued on page 67)
Now! Build the Biggest Bargain in High Fidelity!

Now, Electro-Voice offers the finest acoustically-correct enclosures for your home music system and at a saving to you of up to 50%!

In just a few short hours, you can assemble an E-V KD6 Aristocrat or KD9 Marquis kit without special tools or previous woodworking experience. And you'll obtain the same full sound as the factory-assembled models yet you'll save up to one-half!

Carefully pre-cut and complete with easy-to-follow instructions, each E-V enclosure kit features handsome birch veneer that can be easily finished to match any decor, with complete E-V Finishing Kits. For the final sparkling accent, an AK6 Grille can easily be added.

The KD6 and KD9 are each scientifically designed, acoustically correct enclosures that will add up to an extra octave of performance to any full-range speaker. The folded-horn KD6 uses the corner of the room as part of the horn, to increase performance without increasing size. The KD9 with its rear-facing ducted port provides similar range extension for along-the-wall applications.

Each kit is pre-cut for any 12" speaker. KD9 also accepts 15" speakers. For superb results, choose one of the six E-V 12" speakers ranging in price from $19.50 to $125.00. There is the precise model for your requirements. Both kits are also designed for simple addition of any E-V Building Block Kit. You can start with a coaxial speaker and easily build to a complete 3-way system in step with your budget.

For the perfect combination of performance and economy, put your high fidelity loudspeaker in an Electro-Voice kit enclosure. You'll bring 'em back alive in High Fidelity—at lower cost than you dreamed possible! Write for your free E-V catalog today!

**MODEL KD6 ARISTOCRAT KIT**

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Similar to Aristocrat at left, but for 12" or 15" speakers. Ducted rear port design provides optimum bass response in along-the-wall installations. Size: 20½ inches high, 19 inches wide, 14½ inches deep. Shipping weight 38 pounds. Net each $36.00.

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Electronic Organ Tone Generators

D. WOLKOV

Electro-mechanical tone generators use either the recorded sound of pipe organs or the addition of modified sine waves to produce musical tones.

In Two Parts—Part 2

There are three different types of electromechanical tone generators in today’s organs. Such tone generators, although they differ in design concept and tonal quality, are alike in that they never require tuning. The new Electro-Voice “D” Series utilizes the recorded sound from air pipe organs to generate a capacitance in a manner similar to a condenser microphone. In the second type, exemplified by the Kimball, photo cells scan the analog of a recorded sound of a pipe organ. The third type, the Hammond uses tone wheels to generate modified sine waves from which complex tones are formed by electronic addition.

The Electro-Voice Series “D” organ produces its tones from twelve generators. Each generator has two stationary stators with engraved complex waveforms for each note and each voice. A synchronous motor rotates a scanner which has radial lines corresponding to the number of octaves on the stator.

The relative movement between the stator and the scanner produces a varying capacitance change which in turn produces a varying voltage. The complex waveforms used on the twenty-four stators reproduce the waveforms of the organ pipes from which the originals were obtained.

The Kimball Photoelectric Organ reproduces organ tones by scanning photographic patterns placed between lamp bulbs and photocells. Each of the twelve tone generators encloses a photocell within a metal shell so that the cells are normally dark. The photocell is connected to the organ preamplifier so that if a beam of light is moved across it, an oscillation will be produced. Lamp bulbs illuminate the photocell when the organ keys are pressed. When a bulb is lighted, its light reaches the photocell through successive identical slits which are moved across it. This produces a tone at a pitch determined by the number of slits crossing a lamp bulb is a given time (see Fig. 13). Seven pitches, each an octave apart, are produced in each tone generator. By arranging the slits in circular rows, with different numbers of slits in the various rows, different pitches are produced.

In contrast to the systems just described, single-frequency sine waves are produced in the Hammond tone-generator assembly. The Hammond generator contains 91 “tone wheels” driven at predetermined speeds by a motor-and-gear arrangement. Each tone wheel is a steel disc similar to a gear with high and low spots on its edge (see Fig. 14). As the wheel rotates, these teeth pass near an associated permanent magnet. The resulting variations in the magnetic field induce a voltage in a coil wound on the magnet. The twelve lowest tone-generator wheels are specially cut to be rich in odd harmonics and are used only in the pedal combinations. Each pair of tone wheels is mounted on a shaft and between them is a Bakelite gear held between two coil springs forming a mechanical vibration filter. As the gear is not rigidly attached to the shaft, any pair of wheels which might be stopped will not interfere with the operation of the others. On top of the Hammond tone generator assembly are small transformers and capacitors forming tuned...
No, we haven't forgotten anything. We designed it that way. There are no "user-operated" controls. This is only one of the many features that makes Pilot's unique signal sampling Multiplex circuit—used in all Pilot Multiplexers, Stereo Receivers and Stereo Tuners—simpler, more effective and more trouble-free than any circuit presently being manufactured for stereo demodulation.

TO BE SPECIFIC:
1. The circuit is simplicity itself—there are no controls to manipulate, no special adjustments to make. You can connect Pilot's fully automatic 200 Multiplexer to the FM tuner of your stereo system in less than a minute without any tools, and you never have to touch the Multiplexer again. (The Pilot 100 Multiplexer can be connected just as easily, and in most cases it, too, need never be touched again.) And, in Pilot's Stereo Tuners and Receivers, where the Multiplex circuit is built into the unit, no extra controls of any kind are needed for Multiplex Stereo reception.

2. Maximum separation (30 db or better) is provided by Pilot's Multiplex circuit. The left (L) and right (R) channel signals are extracted directly from the incoming composite signal by means of unique signal sampling and "memory" circuits. Sampling of the composite signal (a combination of \( L + R \) and \( L - R \) signals) takes place at a rate of 38,000 times a second, and the "memory" circuits maintain a constant output signal level between sampling instants.

Other stereo demodulating methods, such as frequency separation and time division, require filtering and matrixing and cannot maintain perfect channel separation across the entire audio spectrum.

3. No frequency separation filters or matrices are used. For this reason Pilot's Multiplex circuitry gives you perfect separation across the entire audio spectrum.

4. An ultra-stable synchronized oscillator assures locking and accurate phasing and maintains high-level performance despite varying input signal levels.

5. Virtually any high-fidelity FM tuner can be used with Pilot Multiplexers for stereo reception.

6. Equipped with the only fully-automatic stereo indicator. The FM Stereo indicator on Pilot's 200 Multiplexer and 654M Stereo Receiver will light and stay lit if the station you're tuned to is broadcasting in stereo.

If you'd like us to be even more specific, we'll be glad to send you a reprint of a December, 1961, AUDIO article which discusses these features in detail.

MULTIPLEXERS (Pilot 100, $49.50...Pilot 200, $79.50) STEREO RECEIVERS (Pilot 654M, 60 watts, FM/MPX, $329.50 ...Pilot 602S, 30 watts, AM/FM/MPX, $299.50...Pilot 602M, 30 watts, FM/MPX, $249.50) and STEREO TUNERS (Pilot 280, $99.95...Pilot 380, $179.50). For further information, see your Pilot dealer or write:

PILOT RADIO CORPORATION, 37-40 36TH STREET, LONG ISLAND CITY 1, NEW YORK
filters for the higher frequencies (see Fig. 15). The design of the organ is such that the fundamental and harmonics may be mixed by the performer in varying amounts. This method permits the generation of a multiplicity of complex patterns for each fundamental note.

Figure 16 is a schematic of one Kinsman tone generator, which exemplifies the class of organs based on the neon-tube relaxation oscillator. The triode tube, half of a 12AX7, is the master oscillator, operating as a variation of the Hartley circuit. The coil, approximately 300 ohms in value, is tuned by means of a powdered-iron slug. \( C_1 \) is the tuning capacitor and \( R_1 \) is shunted across the coil to reduce its \( Q \) somewhat.

While the Kinsman oscillator is essentially of the grounded-plate variety, there is a plate load \( R_p \), so that output can be taken from the plate. The values of \( C_p \) and \( C_r \) are such that a sawtooth pulse is produced.

The frequency-divider stages employ NE-2 neon lamps. A classic neon oscillator consists of a resistor connected to the supply voltage and to one lamp electrode while the other electrode is grounded. Across the lamp there is a capacitor while the other electrode is grounded. Across the lamp there is a capacitor, as well as the characteristics of the lamp, determine the frequency of the sawtooth oscillations.

Although the classic neon relaxation oscillator can be synchronized to an externally generated signal, it cannot be done reliably. Even if all components and voltages were held constant, the lamp would fire at different times because of random firings across the two electrode faces.

It has been determined that two conditions are necessary in a relaxation frequency-divider arrangement for electronic organ.

1. That relaxation oscillator must have a free-running frequency somewhat lower than the desired synchronization.
2. That the method of injection of sync signal must be such as not to reflect back to the source, nor to inject into the output any appreciable amount of the sync signal.

With the correct selection of sync amplitude and timing values (resistors and capacitors), the two lamps may be made to fire only once for every two cycles of the synchronizing frequency. Thus, frequency division can be accomplished. Reference 10 contains a complete analysis of the Kinsman two-neon-tube relaxation oscillator.

Table II lists in summary form the tone generator design approach for a group of representative electronic organs. The characteristics given are not intended as a figure of merit, but to show the diversity of schemes used for tone generation. With an understanding of how organ tone generators operate, we will be ready to discuss in a subsequent article the methods used for changing the output of the tone generators into the complex wave shapes which we hear as musical sounds.

References and Suggestions for Additional Reading


(Continued on page 65)
Can You Afford 15 Hours to Build The World's Best FM/Multiplex Tuner?

Fifteen hours. That's all it takes to build the world's best FM/Multiplex tuner.

Citation has the "specs" to back the claim but numbers alone can't tell the story. On its real measure, the way it sounds, Citation III is unsurpassed. And with good reason.

After years of intensive listening tests, Stew Hegeman, director of engineering of the Citation Kit Division, discovered that the performance of any instrument in the audible range is strongly influenced by its response in the non-audible range. Consistent with this basic design philosophy—the Citation III has a frequency response three octaves above and below the normal range of hearing. The result: unmeasurable distortion and the incomparable "Citation Sound."

The qualities that make Citation III the world's best FM tuner also make it the world's best FM/Multiplex tuner. The multiplex section has been engineered to provide wideband response, exceptional sensitivity and absolute oscillator stability. It mounts right on the chassis and the front panel accommodates the adapter controls.

What makes Citation III even more remarkable is that it can be built in 15 hours without reliance upon external equipment.

To meet the special requirements of Citation III, a new FM cartridge was developed which embodies every critical tuner element in one compact unit. It is completely assembled at the factory, totally shielded, and perfectly aligned. With the cartridge in place, the problem of IF alignment and oscillator adjustment are eliminated.

Citation III is the only kit to employ military-type construction. Rigid terminal boards are provided for mounting components. Once mounted, components are suspended tightly between turret lugs. Lead length is sharply defined. Overall stability of the instrument is thus assured. Other special aids include packaging of small hardware in separate plastic envelopes and mounting of resistors and capacitors on special component cards.

For complete information on all Citation kits, including reprints of independent laboratory test reports, write Dept. A - 3, Citation Kit Division, Harman-Kardon, Inc., Plainview, N. Y.

The Citation III FM tuner—kit, $149.95; wired, $229.95. The Citation III MA multiplex adapter—factory wired only, $79.95. The Citation III X integrated multiplex tuner—kit, $239.95, factory wired, $299.95. All prices slightly higher in the West.
Silicon Rectifier

Q. I have a stereo tape recorder and plan to build another power amplifier. The circuit calls for a power transformer with 365 volts at 500 ma in the high voltage section. I have another transformer which delivers 335 volts at the required current. Can I substitute a silicon rectifier for the rectifier tube, a GZ34, can I get the required voltage?

A. You may pick up as much as 30 volts by substituting a silicon rectifier for a vacuum-tube rectifier. If you are still shy some volts, you might try putting a filament winding of the power transformer, if there is one to spare, in series backing with the primary. (A direct plug-in replacement for the GZ34 is a 1N580 silicon rectifier.) Furthermore, any worthwhile amplifier circuit should operate well at voltages within 10 to 15 per cent of design value. Therefore, if your ultimate voltage still is somewhat less than 335, the amplifier’s performance should not be seriously affected.

Hysteresis Motor

Q. What is the advantage of having a hysteresis motor in a tape machine?

A. The speed of a hysteresis motor is basically governed by the line frequency rather than by the line voltage. This makes it possible to build a tape transport with a high order of speed accuracy. Professional units with hysteresis motors exhibit speed errors of 0.2 per cent or less; whereas many home machines have speed errors of 1 per cent or more. Worse, this speed error may change from one period of time to another; thus under some conditions it may be 0.5 per cent, and under other conditions it may be 1.5 per cent. Hence correct pitch will not always be preserved between recording and playback, even though recording and playback are on the same machine. When it comes to playing commercial pre-recorded tapes, speed errors as little as 1 per cent or less can be offensive to ears with a good sense of pitch, although other ears may tolerate errors of 2 per cent, 3 per cent, or even more.

Not every tape machine with a hysteresis motor necessarily operates within 0.2 per cent of accurate speed. The writer has tested some units with such motors where the error was about 1 per cent. A slight error in machining the diameter of the capstan, the motor shaft, or some other part can result in a speed error substantially greater than 0.2 per cent. On the other hand, the machine with a hysteresis motor retains the advantage of speed stability, so that pitch does not change between record and playback, or possibly between the beginning and end of the reel. A tape recorder with a shaded-pole motor may change its speed between record and playback, or from one day to another, or from one end of the reel to the other, because of changes in line voltage and/or changes in the load presented to the motor.

Magic Eye vs. VU Meter

Q. I am considering the purchase of the *** tape recorder, which has been strongly recommended for high fidelity use, but I note that it has a magic eye indicator instead of a VU meter. How much difference will this make?

A. For home use, this should make very little or no difference. In professional applications, a VU meter is important, for one thing, to assure that the playback signal fed to subsequent studio equipment is of proper level, so that it will neither overload or be too weak to drive this equipment. Such use is not ordinarily made of the record-level indicator at home. For recording purposes, the magic eye indicator actually has an advantage over the meter. The magic eye is an electronic instrument that responds immediately to strong, brief signals (transients), whereas the meter provides an indication of average level. Hence the recordist who operates a tape machine incorporating a meter must estimate the peak level on the basis of the meter reading plus his experience and judgment. The home recordist, using a magic eye indicator, does not have to make such an estimate and therefore incurs less danger of overloading the tape.

On the other hand, the VU meter is a more stable device than the magic eye, so that its indication of recording level is apt to remain more accurate over a long period of time. Also, the VU meter lends itself to fine adjustments of recording level. If you consider buying a tape machine with a meter, be sure that this is a true VU meter, having the frequency response and other standard characteristics specified by the audio industry. There are some meters which look very much like the VU type—same scale and all—but are poor imitations with respect to performance.

Wow and Flutter

Q. I would like a brief explanation of wow and flutter. How much is acceptable in a tape machine?

A. Wow is a slow variation in speed, audible as a quavering effect or one that causes a steady note, such as produced by a piano, to go "sour." Flutter is a rapid variation in speed, which imparts a grainy, buzzy, or coarse quality to a sound. In any tape machine desiring of the term high fidelity, wow and flutter should be undetectable to any ear except perhaps the extremely sensitive one. To judge whether there is appreciable flutter, and also wow, record and play back a steady tone of about 4000 cps, for example. Any small record or, better yet, an audio oscillator; or play back a test tape designed for this purpose. In playback, if the recording is made at moderate level (somewhat below maximum recording level), the tone should sound steady, pure, and sweet rather than pulsating, grainy, or coarse.

Cable Length

Q. I plan to install my tape recorder in a closet about 20 feet from my preamplifier. Is the 20-foot distance all right? The closet doors have small magnetic catches. Will these affect the recording, the tape heads, or the tape?

A. The 20-foot distance is all right for playback only if your tape machine has a low-impedence output. Otherwise you are limited to about 2 or 3 feet of cable unless you are willing to accept substantial trouble loss. Similarly, the 20-foot distance is suitable for recording only if the tape output of your preamplifier has low impedance. If in doubt, check with your dealer or salesmen of your audio components whether they have low-impedence outputs. As for the magnetic catches on your closest doors, they will have no effect unless brought into immediate contact with the tape, heads, or other components.

Loss of One Channel

Q. I have a **** tape deck. Every so often when I am recording or playing back a tape I lose one channel. This is especially true when I first use the machine after it has been idle several hours. I can usually bring back the lost channel by touching one of the terminal leads behind the record/playback knobs, but my question is, what precautions might you have to do to the cause of this annoyance and its remedy would be appreciated.

A. Your difficulty may be a faulty solder connection. A solder joint which has been in operation for a while, the increase in temperature may cause enough expansion at the poor connection so that the tools will get through. When the tools cool, the connection opens up again. Accordingly you may want to check your solder connections.
These two AR-3 speakers provided Christmas music last year for Grand Central Terminal's main concourse, whose capacity is several million cubic feet. Carols and organ music were played in stereo at natural concert volume. Passers-by were often seen looking around for a live chorus or pipe organ.

Relative size does not determine the suitability of small, medium, or large speakers to small, medium, or large rooms. The only criterion by which performance may be judged is the ability of the speaker to reproduce music naturally, without coloration.

The price of AR speakers ranges from $89 for an unfinished AR-2 to $225 for an AR-3 in walnut, cherry, or teak. A five-year guarantee covers parts, labor, and reimbursement of any freight charges to and from the factory. Catalog and a list of AR dealers in your area are available on request.

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Included in this economical system is the Heathkit AD-10C Stereo Record Player with Sonotone STA-4-SD ceramic stereo cartridge and diamond and sapphire stylus; the Heathkit AA-201 6-watt Stereo Amplifier with its exciting new styling concept of black and ivory; and two of the new Heathkit AS-81U Miniature High Fidelity Speakers which feature a 6" woofer of special design and a 3" tweeter for unusual response (cabinet is factory assembled, ready for finishing).

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Power is supplied by the Heathkit AA-151 28 Watt Stereo Combination amplifier ... 14 hi-fi-rated watts for each stereo channel. This tremendous preamp/amplifier value features the patented Heath ULTRA-LINEAR® circuit for extra fidelity, separate bass and treble tone controls, four stereo inputs, speaker phasing switch, and rich modern styling in luggage-tan and charcoal gray.

Ideally matched to the amplifier are the twin speakers, the Heathkit AS-81W duo. The factory assembled cabinets are handsome in walnut veneer. Inside is an 8" woofer, a true compression-type tweeter, and a high frequency level control.

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ensures no intermodulation products can arise, however much the loudspeaker may distort—so long as it does not rattle or buzz.

This Month's Questions

Question C-1. A high-fidelity enthusiast has built an amplifier from a kit. When a friend noticed that the enthusiast did not look happy enough to be a quality job, our enthusiast decided to try a "better" one. Setting a larger unit, with the same ratio, impedance ratings, frequency response, and so on, he installed it, hoping his quality would be demonstrably better. The effort was, instead, it was inferior to the original transformer. For the record, the output stage used push-pull, with the tubes connected as triodes, combined so as to work in Class AB. What could be wrong with the transformer, assuming it tested out well according to specs?

Question C-2. Comparisons were being made between two systems, one rated to have an output of 15 watts, the other 60 watts. Each was operated with the loudspeaker system recommended for it. First test used a piece of program material using a jazz combo, and the full speaker had more power and punch than the 15-watt system. The next test used a symphonic recording, and seemed to do well in such a situation: the 60-watt system folded up long before the 15-watt system sounded too bad; a little distortion might be detected in the 15-watt system, but the complete inability to handle evidence by the 60-watt system.

Why the difference, with different program materials?

Answer B-1. This question frequently crops up. In a correctly designed filter of this type, at crossover frequency there is 50 deg. transfer delay in the low-pass section and 60 deg. transfer phase advance in the high-pass section. This means the two signals at the outputs are precisely out of phase. At frequencies adjoining crossover, the phase transfer angle of each section warps, but retains the total of 180 deg. at all frequencies (theoretically from zero to infinity).

It is usually argued that, for the high and low frequencies to produce their output in correct phase relationship, both units should be in phase; but this would result in out-of-phase operation in the important frequency region where both units are contributing essentially equal acoustic energy. To cover the crossover range of frequencies, the units should be connected out of phase, according to the test, so the acoustic outputs are in phase over this range.

The fact that the high frequencies will be phase-reversed compared to the low frequencies cannot be helped, and is an unavoidable consequence of using a two-way system with this kind of filtering. Figure B-1 shows the correctly completed connections.

Answer B-2. The key to this situation rests in the kind of sound being reproduced. The high-fidelity loudspeaker is invariably called upon to reproduce a complex of sounds all at once. Intermodulation distortion can produce very jarring effects, and resonances will produce spurious coloration.

For the solo organ, on the other hand, the loudspeaker is really part of a musical instrument. The resonances may lend "body" to the tone, instead of coloring it—they are equivalent to mechanical and acoustical resonances that are present in any conventional musical instrument. And intermodulation distortion has no effect, because the organ only plays one tone at a time. Intermodulation products only come when at least two unrelated tones are played together. The harmonic relationship between frequencies in a single organ tone ensures no intermodulation products can arise, however much the loudspeaker may distort—so long as it does not rattle or buzz.

Reader Answers

Following is my answer to Question 1 in the January 1962 issue:

For this response down to 50 cps (no more than 3 db down at this point), the time constant of the circuit capacitances in conjunction with the load resistance can be about 3200 μs. In the circuit capacitances are those of the ceramic pickup and of the cable to the amplifier. We shall assume cable capacitance to be 100 pf, which is quite typical. If a 5 megohm load is required for good bass, this suggests that the ceramic pickup has 540 pf capacitance, making a total of 640 pf circuit capacitance. Multiplying 640 pf times 5 megohms yields a time constant of 3200 μs.

For response down to 50 cps with a 250k load, total circuit capacitance would have to be 20 times as great as with a 5 megohm load. It would have to be 12,800 pf. A ceramic pickup with a capacitance of 6400 μf is required for satisfactory phase and power. To cover the crossover range of frequencies, the units should be connected out of phase, according to the test, so the acoustic outputs are in phase over this range.

The same time this capacitor would cause 26 db over-all reduction in output. In the pickup with 5 megohm load, the amplifier has sufficient gain in view of the signal we can expect from the pickup. Normally, a ceramic pickup may have a capacitance between 1 and 3 volts on peaks. A 26 db reduction would yield peak values between 30 and 150 mv. Many amplifiers have sufficient sensitivity to be driven to full or ample output by such a signal.

If the amplifier lacks such sensitivity, or if the pickup produces a signal below our cutoff, we could use a 500k load control or perhaps a 1 megohm control with a 5 megohm load. In this case, the pickup would contain only a 20 db or 14 db reduction in signal, which for most ceramic pickups and most amplifiers should be enough to drive the amplifier to full output. If the pickup produces a signal below our cutoff, we could use a 500k load control or perhaps a 1 megohm control with a 5 megohm load. In this case, the pickup would contain only a 20 db or 14 db reduction in signal, which for most ceramic pickups and most amplifiers should be enough to drive the amplifier to full output. As the performance is improved, the charge of the pickup pattern is also increased. An 8-element array will have a pickup pattern of 30 deg. between points at which the signal is down 3 db.

Books can and have been written on this subject. Space does not permit a fuller discussion of the working of the array. A little discussion of the working of the array should be sufficient to improve your FM reception. Do not consider using such a device to improve AM reception. You would be rotating a bun hundred of feet in length.
JBL goes all the way—with product warranty as well as product quality. It is—and always has been—JBL’s policy to repair or replace without charge, at any time during the life of a product manufactured by James B. Lansing Sound, Inc., any unit whose performance is impaired by a cause beyond the control of the owner. The only limitation is the availability of parts. And, frequently, it is possible to use today’s parts to bring a discontinued model up to better-than-new performance. This is another reason why it’s a smart idea for the music enthusiast to invest in the very best loudspeakers available. Like any fine musical instrument, they don’t wear out, are almost always worth restoring to top-notch playing condition. Write for your free copy of the new JBL catalog and ask us to enclose a copy of the JBL warranty card.

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FISHER STRATAKITS
MODELS KX-200 and KM-60

These units are two of the newest entries in the kit field, and they are well worthy of the Fisher name, both in performance and in ease of construction. The KX-200 is a dual 35-watt stereo amplifier-preamp, and the KM-60 is an FM-stereo tuner with self-contained multiplex circuitry. Both have excellent specifications, and the performance equals or exceeds the specs.

Each section of the KX-200 consists of an ECC83/12AX7 as the preamp stage with feedback equalization for both phone and tape, followed by the selector switch, a high-cut filter, a tone-control amplifier using another ECC83, the loudness-volume control, another ECC83 as amplifier and direct-coupled phase splitter, and a pair of 709's as the output stage. The output tubes are operated with fixed bias, and both bias and balance are adjustable, with a switchable meter being used to indicate the correct settings. Controls include a tape/phone switch to change equalization in the low-level inputs which are marked MAG 1 and MAG 2, tape monitor switch, loudness contour switch, dimension control which ranges from mono, wherein both channels are coupled together, to stereo, where they are completely separate, balance control, and the usual selector, mode, separate bass and treble tone controls, and the volume control. In addition, there is a center speaker switch which has five positions—off, low, medium, high, and maximum. This switch introduces more or less resistance into the center speaker circuit which is fed from the common top of the left channel and the 16-ohm top of the right channel, with the 4-ohm top of both channels being grounded to the chassis. The meter switch and the bias and balance controls for the output stage are located on the top of the chassis.

There are five inputs for each channel—MAG 1, MAG 2, TUNER, AUX 1, and AUX 2—along with a tape monitor input and a recorder output, with the latter being ahead of both volume and tone controls, which is the logical place for the recorder feed. Heaters of all tubes except the output stages are fed with d.c., and silicon rectifiers are used for both heater/bias and plate power supplies.

IM distortion measured 1 per cent at 36 watts, and harmonic distortion was under 0.5 per cent at the same output. Channel separation measured 52 db at 1000 cps, 28 at 10,000. A phone or tape-head input of 3.4 mv produced full output, with 320 mv being required at the high-level inputs. With the volume control set to give rated output at an input of 6 mv at the phone input, hum and noise measured 69 db down, and with the volume control turned to minimum, the hum and noise measured 96 db down. The tone control range was measured as +10 and -15 at 20 cps, +13 and -18 at 10,000, while the high filter produced a cut of 12 db at 10,000 cps.

The Mag inputs may be used either for phone or tape, and a panel switch provides a change in equalization from RIAA to NAB, the former being exceptionally accurate. Up to about 6000 cps, the NAB curve is exact for 7½ ips, with a drop of 2 db at 10,000 cps and 3 at 15,000—easily compensated for by the treble tone controls.

The KM-60 Tuner Kit

Immediately following the construction of the amplifier, we turned to the tuner. This unit, which is very similar to the factory-built 50-B tuner, consists of a cascode r.f. stage, employing an ECC88/6DJ8, a mixer and oscillator using the two sections of an ECC85/6AQ8, with two 6AT6/6FQ7 amplifier stages and two 6AP6 limiters, feeding a wide-band ratio detector. A meter in the grid circuit of the second limiter serves as a tuning indicator for normal use, while chassis-mounted switch permits connecting the meter to the ratio detector circuit for use in initial alignment. A panel switch feeds the de-emphasized mono signal to the two grids of an ECC85/12AX7 as mono followers feeding the output jacks.

The multiplex unit comprises a 12AT7 signal and pilot amplifier, with the latter's output synchronizing a 12AX7 multivibrator at 38 kc to provide the subcarrier to two diode bridge circuits. Their outputs are fed to the two grids of a 12AT7 where separation compensation is added, along with the de-emphasis for the two stereo outputs, which are then fed to the output 12AX7 asode followers. The presence of the subcarrier signal produces a bias of some 6 volts to the grid of an EM84A, which closes the pattern and indicates that the proper alignment has been completed. Finally, the pilot signal is used to switch in a high-pass filter with 320 mv being required at the high-level inputs. With the volume control set to give rated output at an input of 6 mv at the phone input, hum and noise measured 69 db down, and with the volume control turned to minimum, the hum and noise measured 96 db down. The tone control range was measured as +10 and -15 at 20 cps, +13 and -18 at 10,000, while the high filter produced a cut of 12 db at 10,000 cps.

Chassis view of the two completed Fisher Stratakits—Fig. 1 (left) is the KX-200 amplifier-preamp, and Fig. 2 (right) is the KM-60 tuner.
while you’ve been recording...so have we!


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HEATHKIT MODEL 10-21 OSCILLOSCOPE

While it is true that most measurements on audio equipment can be made with various types of meters used in conjunction with different signal sources, there are still other observations which can be made only with some sort of device which will permit a study of the actual waveform—and that means an oscilloscope.

In the oscilloscope, the “writing” element is actually a beam of electrons which has—to all intents and purposes—no inertia whatever. For example, on the face of a 21-in. picture tube, the beam moves about 20 in. for each scan, and there are 15,750 scans per second, so the beam is actually moving across the screen at around 18,200 miles per hour. On many laboratory-model scopes, the beam can travel some 200 times that fast. In contrast, the beam of a typical 3-in. scope traveling over the limits of the 3-in. reticle at 10,000 cps needs to travel only about 2800 miles per hour.

Needless to say, the requirements of the audiofan do not warrant the expense of scopes capable of handling 100 me, and it is true that some of the finest lab 'scopes cost as much or more than a small automobile. However, within the limits of its frequency range, any 'scope is equally accurate in the presentation of waveform data. The Heathkit 10-21 'scope is a small, compact, and lightweight instrument priced well within the budget of any earnest experimenter, and capable of handling frequencies up to 500,000 cps. It measures 8½-in. high, 6⅞-in. wide, and 16-in. deep, and weighs only 12 pounds—quite a contrast to an elderly 5-in. model we have which weighs 53 lbs. The 10-21 builds in about 7 hours, and is a fine performer after its completion.

Since the requirements of audio and most general radio servicing are not as severe as
those for microwave work, for example, it is possible to reduce the cost of a design by resorting to a simplified design without eliminating any needed function. In the IQ-10, there is no focus control on the panel —focus and astigmatism are adjusted by internal controls which need no tending up throughout the entire range of the instrument. There is no intensity control —intensity is set by the original design. There is no synchronizing control —sync is fed to the multivibrator time-base generator from the vertical amplifier automatically. The two deflection amplifiers are identical, consisting of a cathode follower, gain control, and a driver direct coupled to the push-pull output stage.

**Performance**

The horizontal sweep is calibrated on the front panel in four ranges from 20 eps to 100,000 eps, and will actually sync from 10 to 2300 eps on the lowest range, 90 to 2300 on the second, 1600 to 27,000 on the third, and from about 16,000 to 125,000 eps on the top range. The horizontal expansion is great enough that with a six-cycle pattern on the screen, the pattern can be spread out to permit a full-screen sine-wave of any one single cycle of the six. In the vertical direction, the pattern can be moved up or down enough to view the top or bottom of an entire pattern of a 5-in. square. Terminals are available on the back for direct connection to the deflection plates for observations above the frequency range of the internal amplifiers and of high signal voltages. A switch selects either the terminals or the internal amplifier.

This is the first 'scope we have observed in some time which had all the features required for audio work without undue complication. Precious low-priced 'scopes generally had limitations in overall performance which forced the user to compromise. The Heath IQ-10 does not seem to have any limitations which compromises must be made in any work that the audio engineer, serviceman, or experimenter needs to do.

### OMEGA TRANSISTORIZED STEREO AMPLIFIER, MODEL 1600

At the last New York High Fidelity Show (September 1961) we were introduced to a new piece of high-fidelity equipment —a fully transistorized 30-watt (THFM) stereo amplifier. At that time we noted that it used military-type construction underneath its beautiful exterior. Apparently everybody thought it exciting because we had to wait in line several months before our turn came. You can rest assured that the unit was listened to, "opened up," and under test within minutes after we received it.

The circuit of the output stage is significant and patented. Each output stage consists of four power transistors in a basic symmetrical bridge. The power transistors, constituting the four active arms of the bridge, are driven in pairs; transistors 1 and 4 conduct while transistors 2 and 3 do not, and vice-versa. Associated with each of the power transistors is a driver transistor. Power transistors 2 and 4 are driven by emitter-follower PNP units in phase opposition. Their input signal is derived from a conventional transistor phase-splitter circuit. Power transistors 1 and 3 are driven by NPN units connected as common emitter amplifiers. The input signal to these units is derived from loads in the collector circuit of the PNP drivers. A signal representative of the output waveform across the load is obtained through a novel one-transistor differential amplifier which provides feedback for injection into a low-level stage. Altogether a rather clever circuit.

The Omega 1600 provides balance controls for volume, bass, and treble. After these controls are set to compensate for room acoustics, master gauged controls are used. We found this a rather useful feature, especially since the commonly-used controls sported larger knobs.

The Omega 1600 is the first transistor amplifier we have tested which delivered 30 watts THFM (25 watts rms) per channel. The frequency response was within ±0.5 db from 30 cps to 40,000 cps and ±1.0 db from 10 cps to 55,000 cps. For some unaccountable reason harmonic distortion did not meet specifications (less than 1 per cent) at the extreme low and high frequencies although 1M distortion was within specifications. In all other areas the 1600 performed extremely well. In all, a rather satisfying early production sample.

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**Fig. 5. Omega's Model 1600 transistorized amplifier-preamp.**

**H. H. SCOTT SPEAKER SYSTEM, MODEL S-3**

The first time we observed this speaker system several months ago we were impressed by a very significant fact, the design of the "packaging" (enclosure) was extremely sensitive and handsome. This is significant to us because a speaker system of this type is intended to be a piece of furniture as well as a music reproducer. Anyhow, subsequently we discovered that the visual designer of this unit (and, as we understand it, all H. H. Scott equipment) is no less than the Vice President of the company. We are not sure whether this means that H. H. Scott thinks visual design important enough to rate a vice presidency or that the vice president is an unusually versatile person, but we are glad either way.

The S-3 is a three-way speaker system which utilizes "air loading" to improve low-frequency response. In addition, the crossover network is used to help "flatten" the mid-range response. In reality, the crossover network used in the S-3 is in a manner similar to the way a tone control is used to compensate for room acoustics. Looking at it another way, we can consider the enclosure for the speakers as a "room" with individual acoustics, and the crossover network as a frequency-discriminating device used to boost or cut those frequencies which require it. Since the "room" is constant once the design is fixed, it is only necessary to measure its acoustics, calculate or empirically determine the correction, and "build it in" the crossover network. A clever idea.

The only question that remains to be answered is how well have the H. H. Scott engineers succeeded.

Very well! On the other hand, it would have been very surprising if they hadn't done an excellent engineering job; excellent engineering is really their stock in trade.

More specifically, the H. H. Scott Model S-3 speaker system reproduces music with at little coloration as any bookshelf speaker system we have heard. Both extremes of the audible frequency spectrum are solid while the mid-range has just that touch of brightness that we personally enjoy.
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**RECORD REVUE**

Edward Tatnall Canby*

**VOICES**

The Incomparable Björling. Arias from Italian Opera. Assorted orchestras, conductors.

RCA Victor LSC 2570 stereo

This memorial to the Scandinavian tenor who died in 1960 is a collection out of his later recordings (in stereo), after a 25-year career, which the superlative vocal technique scarcely altered, nor did the voice grow old. Björling has a mild, music-hall tenor compared to the Kery-voiced Caruso or the brassy favorite Melchior in his big days. But Björling has what is now vaguely nonexistent, a real, old-fashioned perfection of vocal production, absolutely never forced and, thus, never forcing the voice itself into overwork. Paradoxically, his finest milieu was in the Italian opera area, where the impact of a perfect technique and high musicianship easily balanced the mildness of temperament that could show up to its detriment in the heavier German roles.


Columbia MS 6254 stereo

The great Eileen, she of the big voice that can sing anything (including popular music), is at her very best in Italian opera even if she does live in Staten Island, New York, and even though her solid American accent does show through a bit here and there. For one thing, she conveys a real sense of personal involvement in Verdi and Puccini, where in other music—including Beethoven and Mozart—one feels a bit too strongly the implication, "So, I can sing this too!"

She can, be assured. But she does it all a bit too costumery, with that immense voice of hers. Not so in these Italian works. She's well worth a heavy try in this recording and in others in her present series of the sort—put her up against Taddei, if you really want an interesting comparison; Taddei being the reigning Italian queen of Italian opera. Farrell can hold her own.

Victoria De Los Angeles and Dietrich Fischer-Dieskau in Duets. Gerald Moore, pf.

Angel 35963 stereo

It is musically correct that three, not two, smiling faces should appear on the cover of this record—Gerald Moore, at the piano, is surely as big an artist as either of the others and the three together make marvellous music, whatever the style or content.

The styles vary pretty widely. We begin with Huntingdon's New World, never faultless, then go on to a Haydn setting (in German) of a Scots air. All Through the Night and a brace of Beethoven's similar arrangements of Irish tunes (in English) with an Irish flavor. In this last, Christian, sung in Italian, Side Two moves from Schoberth through Dvorak, Tchaikowsky...

*780 Greenwich St., New York 24, N. Y.*

Saint-Saëns and Paume—a pretty kettle of musical fish and any other than this superbly musical team would manage to make hash of it. Good musicianship pays; here we have three of its top practitioners.

Rita Streich sings Lieder by Hugo Wolf. Erik Werba, piano.

Deutscher Gramm. 138 641 stereo

A really lovely record, with only a few qualifications. Streich has a lovely and communicative voice for the German Lied, one that conveys, that dictates, that weeps and laughs, with that peculiarly direct honesty and purity of intent that is the most wonderful part of this German song music. Her only mild fault is one that is ultra-common in the case of Hugo Wolf—she can't quite keep up with the complex harmonies when they begin to jump around.

Wolf was a fantastically ingenious composer. Much of the time, his expression is as simple, as well as profound, as anything by Schubert. But every so often—let's say in every third or fourth song—he goes into complex tonal modulations, jumping astonishingly from chord to chord, key to key. Paradoxically in this day of atonality, not many performing artists have the ears to follow his lightning-like complexities. Streich can't, when the harmonic going gets tough, She's like a lopped-off branch that just won't grow fast enough. Nothing obvious; but every so often one feels a cropping for pitch that is mildly unsettling. That's all.

Erik Werba, at the piano, has no trouble, of course. His one aid is aided by the piano keys themselves—which are always in tune, after all.

Leroy Robertson: Oratorio from the Book of Mormon. Soloists, University of Utah Chorus, Utah Symphony, Abravanel.

Vanguard VSD 2099 stereo

On the face of it, this immense oratorio out of Utah might seem the sort of music for outsiders to avoid. I was rather surprised, then, to find that even though it is a thoroughly derivative work it has a certain sturdiness modernity to it and a good deal of rather solid musical construction as well, within the generally solemn oratorio tradition, to which it belongs—stemming back to countless "Messals" and even a Bach B Minor Mass or two. I found I really didn't mind it, though all my intellectual senses kept saying "Boo!"

Indeed, the fervently musical performances by these dedicated Utah people suggests a good comparison, architecturally and stylistically: the music somehow reminds one of the famous Mormon Temple itself, out in Salt Lake City. That sturdiness is nominally a monument to early American architectural naïveté but, even so, it manages to convey an astonishing quality of strength, dedicated worshipfulness and community togetherness. Impressive even if you've just flown in from Notre Dame or Chartres the day before. So it is with this oratorio. Interesting.

Mousorgsky: Songs and Dances of Death; The Nursery, etc. Neotina Devrath, sop., Erik Werba, pf.

Vanguard VRS 1068 (mono)

Neotina Devrath has a lovely voice and an infallible musical ear; she sings almost everything from opera to Israeli folk song. She sings Mousorgsky here, some of the finest dramatic songs of the late 19th century, and I admire half of them, find the other half inadequate. After all, not every singer can sing every song, of whatever sort.

Devrath's voice is light, rather white in tone. In the delightful "Nursery Suite," a set of songs in which a child speaks of his own life in child-terms, she is superb, taking the child's part with animation and musical finesse. But in the stark, terrifying Songs and Dances of Death, Devrath is out of her element. The dramatic element is missing—she can't hear these songs in all their chill fearlessness (and their human appeal) try to dig in her voice, as though on an early LP. Next to that, this one is almost insipid—though musically accurate and beautiful in the singing tone.


Westminster WST 14152 stereo

The revived Westminster label is issuing an interesting series of recordings out of Budapest, where the musical tradition remains so very strong that to this day, and on all sides of the political front. Hungarian-trained musicians are the most brilliant and solid ones, and can find and hold music that was exactly a Hungarian composer, but in his day he did produce what passed for Hungarian music (even if it did turn out mostly to stem from gypsy cafe material). That's enough for present-day Hungarians, who perform him as a national hero.

The trouble with Liszt right now is that though he is just out of a 150th anniversary (his birth, in 1811) his music is at the very climax of "dudeness"—even as it begins to be appreciated for its truly classic qualities of structure and design. You'll find this long, meandering, "symphonic," complete with Inferno, Purgatory and Magnificat, by turns inspiring and an infernal bore. Can't criticize it—for this is the way things were, back in the 1850's. The longer, the better! This is plenty long, especially the soft, mysterious parts and the silences, pregnant mostly with surface noise. Not Liszt's fault; ours for listening at home.

**INSTRUMENTS**

Brahms: Symphony #2. Pittsburgh Symphony, Steuben.

Command Classics CC 11002SD stereo

I haven't enjoyed this old symphony so much since I heard the 1940 Mengelberg Telefunken recording recently released. (See above). And the stereo microphones on this new label is out of this world, a marvellous example of what I might...
A DATE WITH EDDIE CANTOR, Songs, Stories and Anecdotes from his Carnegie Hall One Man Show
Makin' Whoopee • If You Knew Susie • Ida Ma, He's Making Eyes At Me • There's No Business Like Show Business • Dinah • Is It True What They Say About Dixie? • Marjorie • Josephine Please Don't Lean On The Bell • and others
AFLP 702

SOUND EFFECTS, Volume 3
Teletype Machines • Facsimile Wirephoto Machines • Cuckoo Clocks • Grandfather Clock • Clock Ticking (time-bomb effect) • Army Pistol Range • Heavy Artillery • Vulcan Aircraft Machine Gun • M49 Medium Tank • Close Order Drill • Police Car Passing Thru Traffic • Pedestrians In City Street • Thunder And Rain • Rain On Pavement • N.Y. Subway • Model T Ford Starting, Idling, Passing • Electronic Effects • many others
DFM 3011 • DFS 7011

BRASIL, BOSSA NOVA, SAMBAS, MARCHAS
O Apito No Samba • Multa Asanmada • Poema Do Aceus • Covarde • Arrasta A Sandalia • Marcha Mundu • De Zinco • Eu Chorarei Amanha • Lata D'Agua • Nao Me Diga Adeus • Chora Tua Tristeza • Imploar • O Amor • E A Rose • Recordar • Marcha: Madeira De Lei • E Com Esse Gue Ou You
AFLP 1954 • AFSD 5954

MEXICO WITH LOVE, Jo Basile, Accordion & Orch.
La Bamba • Jarabe Tapatío • Malaguena • Chiapanecas • La Raspa • Ay Jalisco No Te Rajes • El Rancho Grande • La Cucaracha • Cielito Lindo • Guadalajara • La Golondrina • Las Mahanitas
AFLP 1946 • AFSD 5946

CARNIVAL DO BRASIL, MARCHAS, FREVOS, SAMBAS
Tumba Le Le • Levanta Mangueria • Pra Só Govertse, Recordar • Na Baix • Do Amor • Se Eu Errei, Me Da Um Dinheiro Ai • Indo Quer Apito • A Lua E Dos Nenomades, Evocacao • Vassourinha, Madalena Va Casar • Cacareco O Malor, Piada De Salao • Maria Escandaloosa • Paie, Quem Me Ve Sorrir • Nao Me Diga Adeus • General Da Banda, Qual O Po • Vai Ver Que E • and others
AFLP 1953 • AFSD 5953

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call Progressive American stereo, imaginatively used not for "literal" concert hall reproduction but to achieve a maximum musical impact in stereo's own terms. European record buyers should try it for their own edification.

To tell the truth, I was a bit put off by the hi-power publicity which launched this label, and for the fancy double-fold albums. Last time this sort of thing came my way, the results in music were distinctly less than sensational, in inverse proportion to the promotional jazz. Not this time.

Yet one thing, (starting from the outside), the albums are fancy but each boasts an excellent and beautiful art cover by a worldwide serious artist—in this case Gabor Peterdi (the notes tell me), whose buff-colored print abstraction makes an unusual cover design. The liner notes are modestly adequate, the technical data only moderately blow-up (35-mm film-recorded) and the general art-layout really in excellent taste—which means that it is harmonious, beautiful in its color scheme and well-proportioned in the typography.

But the disc is what counts. And for me it isn't necessarily the 35-mm film-recording that gives such a lovely sound but, as I say, somebody's highly intelligent and sensitive use of the stereo milieu. I suggest that Con¬man has done a good deal better than Cap¬itol did with this same group, though that was in an earlier stage of the fast-moving stereo art.

And finally—the music, Command, by acci¬dent or careful choice (I wouldn't know), has inherited one of the finest, most musical of the American orchestras and one of the best conductors in the business for the big classics. The first two movements of this performance are just plain lovely—for any listening ear at all. The other two go sort of fast (maybe the LP wasn't big enough) but even so, there is no lack of clarity and sweet¬ness. "Natural" is the best word for the Steinberg sound. Natural in terms of today, which means straightforward and minor, Ro¬man-style frails, yet lyric, cleanly played and phrased, always balanced and well con¬trolled.

If you want to hear the marvels inside a Brahms symphony, the multitude of concert¬measures, the color con¬chuc, the play of the orchestral choirs, this semi-close-up "cur¬tain of sound" has already sold 50,000 of this disc. You'd better try one, too.

**War-Time History**

**Brahms: Symphony No. 2. Concert¬gebouw Orch., Mengelberg.** (Recorded April 9, 1940)

**Telefunken TH 97005**

**Tschaikowsky: Symphony No. 6 ("Pathétique").** (Recorded April 22, 1941). Concertgebouw Orch., Mengelberg.

**Telefunken TH 97002**

Historic recordings with a vengeance, these. How strange is musical history when it is lined up against the larger world in which it exists! I thought, somehow, that the dates above might be especially significant. I rushed to my "Rise and Fall" ('Rise and Fall of the Third Reich," by Wm. L. Shirer) and lo—the great Wilhelm Mengelberg, one of the finest conductors of the early century, recorded this Brahms with his Dutch orchestra on the very day of the inva¬sion of Norway by the Germans and the sudden overrunning of its small neighborhood, Denmark. The Norwegians fought for awhile, but the Danes never even had a chance to try. And there, only a few miles away on that day, was Brahms, serenely lived, played in the great tradition of black Romanticism in which the symphony was composed, led by a man who had taken over this orchestra before the fall of the nation, Denma¬rk.

"It was only a month later that the first invasion with which completed the con¬quest of Europe overwhelmed Holland itself, in a mere five days of terror."

What do we have, then, on the second of these discs? April 22, 1941? On that April 22, Hitler was in total charge of Europe, including Holland, and obviously including the Concertgebouw Orchestra and its famous leader. An unspeakable aspect of his last years but a complex one, as this superb Mengelberg, "Pathétique" attests.

On that April 22, Greece was about to collapse and Yugoslavia's pathetic little revolution had been crushed by Hitler; the great invasion of Russia was already overdue, postponed until the late days of June. And here was Mengel¬berg and his orchestra, and Fritz Kreisler Tschaikowsky's last symphony, tragically played as it seldom has been since in a style no longer really possible today. A superb, priceless performance.

Is there anything Hitlerian about it? Well, the Dutch string section is pit¬itably weak, a handful of fiddlers, placed close to the microphones. War-time at¬tribution. Much more significant, the tech¬nical quality of the sound is startlingly improved over that of the Dutch recording of a year earlier, Fabulous! And sinister—for this must have been the sudden influence of German technology. At such a time, heath, such is life, and Telefunken (via London) is aesthetically 100 per cent right in bringing us a splinter of outstanding recordings, cut out of a troubled history.
Instruments of the Orchestra. Commentary by Yehudi Menuhin. 50-page ill. booklet. Capitol H8Z 21002 (2) mono

Recordings of the instruments of the orchestra, for educational use, seem to pop up regularly every year or so. This British one has the best-played and best-recorded musical examples I've ever heard, done in a very natural liveness, as at a musical recording session, and contrasted deftly with orchestra passages excerpted from EMJ recordings. (The comparison between a solo instrument close-up and the same in its naturally distant orchestral surroundings has too often been badly handled, or simply ignored.)

Yehudi Menuhin is the earnest, somewhat pedantic-sounding commentator. There is no doubt of his sincerity, and the information he conveys is useful and succinct. It's just that somehow, the tone of his voice has that "educational" sound to it, much prized by music educators and generally abhorred by the public at large and by children in particular!

Not unpleasant, mind you—and you must produce some tone, if you're going to talk, after all. I've heard a great deal worse, perhaps than Menuhin, which implies really that at all, for he is a real musician. Just mannerism, a way of speaking.

The tape editing of the recorded excerpts is poor—chummy fade-outs, more or less at a proper stopping point but ill-managed and badly framed. I know—I do it every week myself with records, on the air, and I could do better than this.


RCA Victor LSC 2567 stereo

A fine pair of works here, both of them associated most honorably with the Boston Symphony and its home auditorium, Symphony Hall. The Poulenc is one of his Mozartian pieces (after many years of gritty French hijinks), dating from 1938, not unlike the very popular two-piano concertos, with plenty of serious but catchy melody and some pleasantly hard rhythmic variety.

The Stravinsky "Card Game" is also in the high neo-classical tradition (1936), Bach-like in its steady, pulsing rhythmic meter, ingratiating to the ear of today as though already out of a classical period in the past—which it is to be sure. Music now is harder stuff than it used to be; the atomistic age.

The piece is composed in "deals," with a special bit of music to accompany the card-shuffling, and the plot involves complications provoked by the gulf of the perfidious Joker. As the liner notes put it, this is a "waggish" piece—and an amusing one for almost any hi-fi listener.


London CS 6210 stereo

There's nothing I love so much as Ravel well played—and here is a whole record of the very best of it. Ravel, the essence of a Frenchman, is a somewhat special taste, I admit—people either enjoy him moderately or (like me) find his influence as essential and powerful, every so often, as owing to a quarter. One must delicately roll in Ravel and that's the way I feel about his marvelously lush, beautifully tender, elegant, sophisticated, super-erotic music. A real man of his type, and one of the great musical personalities of his age.

Ansermet, the bearded Swiss, is in truth far nearer to the French temperament, albeit in a suitably weighty fashion, than he is to that of the Germanic peoples whose music he also plays—Beethoven, Brahms and the rest. This is just plain super French, especially the "Tombeau de Couperin," and only the "Valses Nobles" seem to me somewhat less potent here than I've heard them elsewhere at their best.

---

WHAT CARTRIDGE SHOULD YOU USE IN YOUR RECORD CHANGER?

T he selection of a cartridge for use with a record changer—mono or stereo—would appear to pose no special problem. Yet, there are certain things to be considered.

A cartridge that tracks at some featherweight fraction of a gram may introduce problems if the record changer arm is not capable of tracking at that force. To adjust it, and attempt to use it at such a low force may introduce complications. Joe Marshall, noted audio authority, discussed this in his article INSIDE THE CARTRIDGE (High Fidelity Magazine, Jan. 1962)—"An attempt to reduce needle pressure with an arm not designed for low needle pressure will usually result in high distortion due to loading the needle with the mass and friction of the arm."

Induced hum is another problem to be considered and anticipated with a magnetic cartridge. The very nature of the magnetic cartridge makes it an efficient hum transducer. In the field of an unshielded AC motor, it is prone to reproduce hum in the loudspeaker system.

The record changer owner must make fairly certain that the tracking capabilities of the arm and motor shielding are suitable for use with a magnetic cartridge. He can avoid these complications, and enjoy superlative performance by selecting a ceramic stereo cartridge.

Sonotone was the first to develop the use of ceramics in piezo-electric phono pickup applications. And today, the Velocitone cartridge stands out as one of the most notable attainments in high quality record reproduction. The Velocitone tracks at 2 to 4 grams — well within the capabilities of any record changer arm. And it will perform in the magnetic field of an entirely unshielded motor without the trace of magnetically induced hum.

With magnetically induced hum and stylus force problems out of the way, here's the kind of performance you can expect from the Velocitone, usable frequency response from 20 to 20,000 cycles (+ ½ db from 20 to 6,000 cps; ± 1 db from 17,000 cps). Output is 11 mv. per channel with better than 25 db separation.

The Velocitone is provided with matched equalizers (no tools required) so that it operates as a constant velocity device, and can feed directly into the 'magnetic' phono input of any stereo preamp. What's more, the Velocitone's performance is unaffected by extreme temperature and humidity changes.

The Velocitone, priced at $26.50 with two 0.7 mil turnover diamond stylus, gives you, in effect, two cartridges for the price of one. With diamond/sapphire combination, the price is $23.50. Ask your hi-fi dealer to demonstrate the Velocitone, the cartridge that is performance-matched to your record changer. Write for descriptive literature.

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Washington WR 442 (mono)

Catering to the Baroque-Rococo trade, the circumstances Washington label here offers a somewhat spectacular special—these two are perhaps the greatest living flute players of today, one American the other French. (Washington releases few records but chooses with care.)

Two flutes, no accompaniment. A fine sound, and much of the music is decidedly worthwhile—it involves a piece by "Haydn (?)", a Telemann Sonata, an Allegro and Minuet by Beethoven, out of his earliest production at Bonn three years prior to "Opus 1," and a longish Duett by Kuhlau, a flute player who fled the Napoleonic Wars and settled happily to a life of flute production for the King of Denmark.

One of these pieces, or two, may be enough at a time. If you will space them out in your listening, you'll find each a fine exercise in top-form flute playing. The tiny, significant contrasts of tone and technique between the two men will keep flute players' ears extremely busy.

Aristid Von Wurtzler, Harpist.

Aristid Von Wurtzler is a top harpist, a young refugee from Hungary after the 1956 revolution, a soloist with the New York Philharmonic—and his recording is a plain bore. No better can be said, though this is not uncommon as a result of the kind of international professionalism that gets onto this record.

Why? Well, nobody can deny that M. Von Wurtzler is a fine harp player—he is but when his Barték, praised by Kodály himself, turns out here to be no more than a handful of those tiny, half-minute children's pieces of Barték, that sound much better in their proper piano version with an international solo, when a Von Wurtzler performance of a well-known Handel Passacaglia sounds as though Handel were a late-19th century Harper on a small scale—which he was not, when the meat of this disc finally emerges (as might have been expected) as we arrive, come side 2, at the real harpy pieces, all fancy trills and runs, à la Marp Marz—then, well, I'm just not a harp player myself. Nor, probably, are you.

This is strictly trade stuff, showing merely that the Budapest harp training is much like too much other harp-instruction, tending towards narrowness, compounded. Fine for harpists.

DOCUMENTS

Portrait of a Splendid American—A Documentary Tribute to Dr. Tom Dooley.
Columb ia ML 5709 (stereo)

This is a first-rate documentary in the highest sense of that term—for though it ostensibly presents facets of Dooley's hectic life as a tribute to him, in actuality it affords all of us a first-hand opportunity to hear for ourselves how this somewhat controversial young man "worked," to hear the intensity of his dedication to his medical cause, to assess with our own ears—as he speaks—whether we feel one way or another about him.

Dr. Dooley, you'll remember, went out to Laos and stirred himself mightily in favor of the native population. He was a kind of dynamic whirlwind Dr. Schweitzer-passionate, where the older Doctor was quietly philosophical, vivid for publicity in his cause, where Schweitzer was cautious (and still not frenetically high-tension in contrast to Doo ley's enduring calm). And Dooley died of galloping cancer right in the middle of it all, thus quickly ending a career that perhaps was somewhat spectacular for its own sake.

Was it? Well, you can judge for yourself, via the abundant quotes from Dr. Dooley's own speeches and broadcasts, on-the-
scene and on visits home. No question, he was a highly volatile and abundantly endowed young man with an extraordinarily compelling personality. That personality comes through with disturbing vividness here. Congrats to KMOX, St. Louis, which produced this show originally for radio.

The Story Teller . . . a Session with Charles Laughton.
Capitol STBO 1650 (2) stereo

This is a humdinger of a set. I'm only part-way through the four long sides at the moment, but I've been caught for fair, and so will you be. The man has a stage personality and a mike personality that is just amazing! One minute, and you'll be rooted to your speaker until it's all over—from Shakespeare to Jack Kerouac, from the Bible to “Major Barbara” by Bernard Shaw, plus a liberal sprinkling of small talk and large talk, off the cuff, to tie the whole thing together.

Here, by the way, is an excellent example of an audience recording, a “live” performance on records. It goes along with many another, ranging from pure slapstick and Milt Kamen all the way to “Mark Twain Tonight.” In a “live” recording of speech, you see, the audience is very much in evidence and audibly a real part of the show, with its constant laughs, applause. Your imaginative awareness of the “live” situation is thus perfectly sustained, in the living room. With music however, the situation is quite different. Audience noises is obtrusive, even in very small quantities, and so is the relatively stiff applause that accompanies a formal concert.

This kind of “live” performance is a natural for records, though music rarely is.

Sviatoslav Richter at Carnegie Hall: All-Beethoven Program (Vol. 1).
Columbia M2L 272 (2) mono

There’s a fascination to that magic phrase, “So-and-so at Carnegie Hall,” a cachet that goes with a live performance of distinction, apt to be historical. This concert was all of that; but I have reservations as to its value in the recorded form.

Don’t forget, in your excitement over Richter, that a record is always a record. (And particularly when the pianist, as to rumored hero, insists on a mike that is out of sight and mind—hence the somewhat inadequate mono sound in this series.) Keep in mind that the recorded medium has its own values, makes its own demands, projects its own sorts of virtues as well as defects. It is always necessary to apply a separate judgment to the musical values of a “live” concert and its recorded duplicate; the two are often very different in musical impact.

On these records, Richter is exactly what we should expect him to be, a big pianist, a big-audience man, playing on the grandest scale to vast, attentive, enthusiastic crowds of admirers. We are in on a spectacle, and we listen close-up (relatively close, though the piano is off-mike by normal recording standards); we are intimate witnesses here to a show, in musical terms, that is aimed big, spread wide, shaped on a huge scale.

Could it be otherwise, in such a situation? Clearly not—and even the critics on the spot, live, had a sense that some of this Beethoven was a bit larger than life, notably in the early Sonata Opus 2, Number 3, which is essentially a piece for room-size playing and not its best in that milieu.

We are room-sized listeners, via records. The recorded medium is basically for living-room-venue. True, we can “set in,” on a spectacle such as this. True, we can be persuaded of music’s sheer size by means of tricks, via big liveliness, for instance, as recording engineers now know so well. But when it comes to the real thing, as here, we feel an inconsistency. Like being a couple of feet from La Callas when she hits a high note, or maybe, heading over Helotes’ neck as he stretches off a fiddle cadenza. Much larger than life, and a bit overdone, for the living room.

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-3.
So it is with Richter. One senses the electric atmosphere, all right, by the almost hysterical applause that bursts out instantly after each piece, but one notes the sudden intrusion—having forgotten during the playing that there was such an audience! (Columbia has reduced many of the audience's coughs to a sort of gassy hoot, which I find more annoying than the genuine, natural kind.)

In the early Beethoven, the show is too close-up, too potent, too big, for any normal living room. In the "Appassionata," however—a show-piece if ever there was one—Beethoven takes off with astonishing effect. That piece is right at home in the concert hall, and at home with Richter, too. Yes, he's a great dramatic pianist, a master of big-time performance. But the thoughtful intimacy of the chamber music approach is not his specialty. You'll need to listen to him on records with this in mind.

Spanish Songs and Dances in Motion.

Jose Greco and His Dance Company, Orquesta de Conciertos de Madrid, Machado.

Columbia MS 6265 stereo

Here's another of those Spanish song-and-dance recordings that feature the sounds of the dance itself as well as the accompanying music. This one is rather sophisticated, as benefits a famous touring company. Part of it involves a full symphony orchestra and a Spanish one at that.

But here's a warning about this presentation. The more intimate dances have the requisite close-up sound of guitarra, slapping of cymbals, clapping of hands, rattling of castanets and, of course, the brittle rhythms of hard heels and soles on hard wood flooring. Some passages—as in the new style in Spanish recordings—dispense entirely with music for considerable stretches, in favor of sheer rhythm. Very nice.

Virtually every piece (or dance) seems to be somehow "arranged" by its symphonic conductor, Machado, or so the record label says. "Machado-Greco" is the way it gets printed. Since Spanish dancing is supposedly still quite improvisational, traditional, and highly rhythmic—with the feet and body—I'm not clear as to how or what the "arranging" involves—let this pass. It sounds good, arranged or no. (Can you copyright some fast foot work in terms of recorded sound???)

STEAM PLUS

2nd Pigeon and the Mockingbird. (Sounds of Steam Railroading, Vol. 4.) O. Winston Link.

(O. Winston Link Railway Prods. 58 E. 34th St., New York 16, N. Y.)

"2nd Pigeon," believe it or not, is the name of a train, one of the last coal trains to be hunted by steam on purpose (as opposed to those that are caught by fans or commissioned by recording outfits!). And this record, continuing the O. Winston Link tradition of interesting side-effects, does feature a full-fledged and genuine mockingbird, no fake nor even a caged birdey but a singer who just happened to come along and stay awhile.

In case you didn't know, mockingbirds belong in the South but often straggle Northwards—and, oddly enough, the Northern strays often turn out to be exceptionally good singers. The theory is that they have nothing to do but imitate the surrounding noises, minus the company of their own kind. Moreover, mockingbirds (as I've observed myself) clearly like people and enjoy showing off near any scene of moderate human activity.

So, you see, this mockingbird came around to inspect the Link tape recorder and spends a bit, to stay. After awhile, a steam train comes along... It's 2nd Pigeon.

Most of the record is the usual sequential account of complete trains, episodically described in the accompanying liner notes, which you must read as you listen. Link invented the idea, far as I know.

Steam Railroading Under Thundering Skies.

Mobile Fidelity MF 8 stereo

Well, this one has added sound-effects, too. "Havoc! February, 1961! The full force of Mother Nature strikes Houstoria, Min. The stark reality of devastating rain and high center..." Public relations in high gear, if you ask me, and I'll bet the guy who wrote that blank didn't even have a bat. But there's a real, honest thunderstorm here, just the same. One of those that keep coming back again and again (pre-frontal squall lines, I'll insert in my capacity as an amateur meteorologist). The thunder crashes are solid enough and reasonably frequent, the rain just keeps pouring down and down, wetly. In the middle of the record I looked out my window at a perfectly dry city street and jumped perpendicularly.

Against this sultry storm there is a train, match. Old engine No. 300, 2-8-2, comes rumbling along with its train of cars. No. 300 just like an old small freight to me, and my only objection is that, as we listen, this train also keeps coming back, over and over again. I can't figure out its schedule.

The second thing seems to be shuttling hardly over a couple of miles of dead-end line, judging from the sound. Who's whassa, who's 2nd Pigeon, who's WOO O echoes the whistle through the stormy Mississippi hills, then choo-choo-choo-choo-choo-rattling-steam-bang, and off it goes into the distance—only to turn right around and choo-choo straight back again to us once more. After a few times, this gets to be rather many. Has the engineer gone mad? Or maybe it's a circular track.

Just a rather unimaginative job of tape editing, I suppose—but what, after all, are you going to do with one old steam train for a whole LP side? Can't just record it once on the daily run-through, then wait 24 hours for the next time.

There's a different train on the other side. Steam trains being so scarce, two complete trains, all different. It's a pretty good thing, single LP.

52

WHEN A PAIR OF ACES MAKE A FULL HOUSE

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MIXER
(from page 23)

be doubled except for those items marked with *

Resistors

- 1/2w, 1%
- 5-100Ω
- 5-333kΩ
- 5-18,000Ω
- 2-100,000Ω
- 2-220,000Ω
- 2-560,000Ω
- 2-267,000Ω
- 2-470,000Ω
- 2-1 MΩ
- 2w, 10%
- 5-100kΩ
- 5-10,000Ω
- 1-27,000Ω
- 2-47,000Ω
- 1-120,000Ω
- 1-340,000Ω
- 1-620,000Ω
- 1-1 MΩ (potted)
- 2w, 10% (potted)
- 1-22,000Ω
- 1-33,000Ω
- 1-55,000Ω
- 2-66,000Ω
- 1-110,000Ω
- 1-113,000Ω
- 1-224,000Ω
- 1-320,000Ω
- 1-448,000Ω
- 1-550,000Ω
- 1-100,000,000, 2w, pot.
*1-500,000,000, 2w, pot.

Capacitors

- 1—1μf/300v, ceramic
- 1—1μf/300v, electrolytic
- 1—1μf/300v, electrolytic
- 2-10μf/300v, electrolytic
- 2-1μf/300v, electrolytic
- 2-1μf/300v, electrolytic
- 2-6μf/300v, electrolytic
- 2-6μf/300v, electrolytic

Switches

- 4—spst, toggle
*1—spst, rotary
- 4—spst, lever action
- 1—tpst, lever action
- 1—10 position, rotary

 Tubes

- 2-12AX7
- 5-12AU7
- 1-12AJ7 (1/2 tube/channel)

Miscellaneous

- 4—shorting jacks, J1→J4
- 3—open circuit jacks, J5→J7
- 1—VU meter (Argonne AR-331) with 3600Ω resistor

Parts List—Power Supply

Resistors

- 1/2w, 1%
- 5-170,000Ω

Transformers

- 1—T1, 117v isolation (Triad N-51X or equivalent)
- 1—T2, plate (Stancor PM-8419 or equivalent)

Tubes and Diodes

- 1-6AU6
- 2-12B4
- 1-56G1
- 4-120 ma, 600v diode
- 2-100 ma, 600v diode

Miscellaneous

- 1—spst switch "on-off"
- 1—fuses, 1/4 amp, fast blow
- 1—fuses, 0.4 amp, slow blow

an astounding new sound...

an incredible new cartridge

Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois
STEREO
Shorty Rogers: The Fourth Dimension In Sound
Warner Bros. Stereo BS1443

To meet stereo competition from all quarters, Warner Bros. has set up a Stereo Workshop, given its engineers carte blanche in regard to engineering facilities, and is launching a series designed to test audiophiles and arouse the curiosity of musitians. In keeping with the avowed intention of "expanding echo to the entire assembly of sound," the first three albums introduce a number of new effects, some of which are novel and ingenious enough to astound the fashionables of electronic music. The initial jazz offering comes from Shorty Rogers, a seasoned veteran at trying out unusual combinations of sound, and he handles the multiple duties of arranger, conductor, flugelhorn soloist and supervisor of the final remixing without missing a trick.

As remixing involves six to twelve takes, the need for close cooperation between arranger and engineers in preparing the two final tape channels must be fairly evident. In fact, conferences begin well in advance of recording sessions, and each piece is carefully plotted in terms of time and space. Not only does the six-track recording permit complete flexibility of positioning to breadth, but the amount of reverberation can be individually controlled on signals from all instruments to the entire ensemble. All instrumental sections are placed in depth at will, without affecting the overall session or by remixing later through the console.

Even confirmed opponents of artificial reverberation were surprised at the amount of the effects brought off by Workshop engineers, who seldom stoop to anything so simple as applying echo to the entire assembly of sound. Not only does the six-track recording permit complete flexibility of positioning to breadth, but the amount of reverberation can be individually controlled on signals from all instruments to the entire ensemble. All instrumental sections are placed in depth at will, without affecting the overall session or by remixing later through the console.

Both claims are made that the "infinite" supply of "echo leagues" he has at his disposal is the result of a system of sound generated by means of a "Reverberator," which is a development of his "natural" approach in studio work. This is neatly arranged to make the nine Jazz Stars sound like fourteen ordinary players, and the trio responsible for turning the trick is neatly arranged to make the nine Jazz Stars sound like fourteen ordinary players, and the trio responsible for turning the trick is neatly arranged to make the nine Jazz Stars sound like fourteen ordinary players. Such an approach to sound engineering is bound to arouse the curiosity of musicians. In fact, Shorty Rogers introduces a number of new effects, some of which are novel and ingenious enough to astound the fashionables of electronic music.

The audio enthusiast who learned about high quality Polymax pressings from Riverside's Fortissimo XK series will welcome news that Warner Bros. also is adopting this superior material. Manufactory research reached a point just thirteen months after pressings for two patent marks next to the engraved number matrix. The result: eleven minutes, one second and twelve thousandths of an inch, which are colored black and the grooves play from the outside edge. Owners of good equipment should be able to discern the advantages in clarity and presence when comparisons with ordinary pressings are made on their turntables.

Chemists working at Research Craft Corporation discovered Polymax, which is processed as an additive to harden and convert pure vinyl resin into an improved medium for preserving delicate sound impressions, and Stereo Workshop pressings were shipped for review from the Los Angeles plant. Ewing Young's Audophile is another label which has played a part in the development of the new compound. The new compound has been sampled early pressings without knowing it. Since the last Fortissimo XK release, the manufacturer has increased his list of claims and now states that pressings are free from internal stresses, thereby making possible warp-free records and a product of less weight.

An array of photographs taken by means of polarized light supports this revolutionary claim, and the stress areas in various vinyl mixes are clearly shown. Just to make the point even more convincing, the Polymax pressings are now being tested containing some signs of stresses pictured along with one of the latest, in which stress appears to be completely vanquished.

Polymax is a self-replenishing groove lubricant reduces the tendency of the stylus to "skate" up and down the side walls. The term "skirt effect" might be more accurate and do away with any confusion, as the result when high frequencies narrow, the stylus jumps out of the groove in what causes the stylus to ride up side walls. Lubrication does lessen friction and helps the stylus "stick" to the record surface of the passage, but this term usually refers to a tone arm moving across with the stylus riding up the side walls.

Although both claim the same last name, the "lookin' good" part they are playing in the revitalization of jazz is in and around Los Angeles, a region still better than thirty miles away from the old Larrabee plant. Neither category quite fits Joe Gordon, whose trumpet playing won unanimous praise for "The Polymax Mystery." The answer lies in the Fortissimo XK and Stereo Workshop pressings, and critic J. W. Wartell, who would judge it to be the solution of their toughest problem.

Joe Gordon: Lookin' Good
Contemporary Stereo 57597
Dexter Gordon: Doin' All Right
Blue Note Stereo ST84077

This jazz version of a Broadway musical is neatly arranged to make the nine Jazz Stars sound like fourteen ordinary players, and the trio responsible for turning the trick consists of Jimmy Heath, Ernie Wilkins and Melba Moore. All the writing chores around increases the odds in favor of a more varied treatment, yet the risk of conflicting themes is easily avoided here. In this case, the division is labor is fairly even, with both ballads and swingers being shared by all, and everyone cooperates in creating fresh jazz lines.

Riverside Jazz Stars: A Jazz Version Of Keon
Riverside Stereo RLP3997

The jazz version of a Broadway musical is neatly arranged to make the nine Jazz Stars sound like fourteen ordinary players, and the trio responsible for turning the trick consists of Jimmy Heath, Ernie Wilkins and Melba Moore. All the writing chores around increases the odds in favor of a more varied treatment, yet the risk of conflicting themes is easily avoided here. In this case, the division of labor is fairly even, with both ballads and swingers being shared by all, and everyone cooperates in creating fresh jazz lines.

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LEAK

"SANDWICH SPEAKER"

Ever since the invention of the moving-coil loudspeaker in 1925, the achievement of TRUE PISTON-ACTION has been the long sought-after goal of loudspeaker designers. But due to the limitations of available materials for cone construction, even the finest speakers, to this day, have fallen short of this goal. Flexible paper, composition or cloth cones are inefficient pistons at best. Because of this unfortunate flexibility ordinary speaker cones buckle—creating "breakup" distortion. Various areas of flexible cones move with different intensities—often in opposite directions, resulting in distortion peaks and troughs. (Diag. A.)

Now, from the renowned laboratories of H. J. Leak & Co. Ltd., comes the most revolutionary invention since the moving-coil loudspeaker—the LEAK Piston-Action "Sandwich" Speaker—only in the new Leak sandwich speaker does the speaker cone give true piston-action—each point on the cone surface moving in the same direction—at the same time—giving excellence of transient response—no peaks, no troughs, no "breakup" distortion! (Diag. B.)

The Leak Piston-Action "Sandwich" Speaker is a totally new, advanced invention! Aerodynamic sandwich structure principles gives its cone 3,000 TIMES the stiffness of a paper cone of the same mass! This results in remarkably smooth, uncolored, natural reproduction of sound ... incomparable quality never before heard! A Leak Piston-Action "Sandwich" Speaker will be available soon for demonstration at select Audio Specialists ... you may have a short wait before you can own one!

The British Experts Say—

"This design must be regarded as a breakthrough of fundamental and far-reaching importance. If you seek improved sound of natural quality in mono-or stereo combination, you will be hard put to find this LEAK system..."

—AUDIO & RECORD REVIEW (Gr. Brit.)

"One of the best loudspeakers one could buy, and can be fully recommended."

—GRAMOPHONE (Gr. Brit.)

"The (LEAK) speaker undoubtedly sets a very high standard and will make many friends."

—HIFI NEWS (Gr. Brit.)

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In Canada: ELDON INDUSTRIES, SCARBOROUGH, ONTARIO
Gary McFarland: How To Succeed In Business Without Really Trying

Verve Stereo V68443

As this helpful guide to the corporate way of life seems to be entrenched for several seasons on W. 46th St., quite a few arrangers are likely to attempt jazz versions of the Frank Loesser score from time to time. If they hope to outdo Gary McFarland’s success with this first venture, everyone concerned had better abandon the precepts of the book and really try. A youthful virtu from the West Coast, McFarland has branched out as composer and arranger since migrating east, writing for Gerry Mulligan, Anita O’Day, Johnny Hodges and Bob Brookmeyer. He tackles his debut album with a zest and enthusiasm befitting any junior executive, and the managerial eye of all major labels are sure to watch his progress from now on. Most of the songs are tied to characters or situations on the stage, but McFarland removes all such shackles and treats each theme as freely and expansively as the big band would a pretense customer on an evening out. The energetic title tune is uplifted further by a touch of gospel fervor, and a blues feeling adds to the nostalgia of Grand Old Joe. McFarland trusts the book’s main premise enough to delegate the authority for numerous ad-lib choruses. Much of his success results when the trying is turned over to such competent members of the jazz world as Frank Rosolino, Bob Brookmeyer, Oliver Nelson, Al Cohn, Hank Jones and Kenny Burrell. In fact, he practically hands the book’s role to Clark Terry, whose trumpet and flugelhorn work is witty and lyrical throughout. If Terry keeps on playing so much better than other trumpet soloists, a sign may go up on his desk someday bearing the title “The Thinking Man’s Jonny Jones.”

Henry Mancini: Combo!

RCA Victor LSP2258

Jonah Jones: Broadway Sings Again
Capitol Stereo ST1641

While many factors enter into the makeup of a combo, there are really only two kinds — those that play arrangements and the others. Extremes of both types take the field and our reviewer pros and cons up the arranger-composer’s end in his usual masterful fashion. In fact, it would require the energy of the entire band to budge him, at just the right moment to send his stock as vibist soaring.

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Announcement of the new R·A·E Society has received overwhelming response. Charter Membership applications from kit-building enthusiasts are pouring in from every section of the country. Long-time kit-builders, new kit-builders, and will-be kit-builders are as one in applauding the R·A·E Society idea for people interested in building radio, audio, electronic kits. The Society will help you, too, to derive more enjoyment and satisfaction from the fascinating hobby, and show you how to achieve the best performance possible from kits you build.

KIT ENTHUSIASTS CITE R·A·E SOCIETY BENEFITS

Many letters accompanying applications cite the various benefits offered by the Society as reasons for seeking membership. Most often mentioned:

1. The R·A·E Quarterly Journal received the greatest number of mentions as the only publication devoted exclusively to kits and kit-building. (No music articles, no record reviews)
2. The Advance-Test Panels excited interest with the plan to have members pre-test new R·A·E kits before they are marketed and, in so doing, receive the kits absolutely free.
3. The Members' Roundtable and other departments of the Journal devoted to members' correspondence, brought favorable comment as an opportunity to exchange ideas and experiences, opinions and recommendations, to help others, and to learn from them.

One applicant summed it up: "This looks like the best $1 investment I ever made."

R·A·E QUARTERLY JOURNAL

Milson B. Sleeper, noted figure in electronics and Chairman of the R·A·E Society, heads the editorial staff of the Society's Journal. This unique publication, elaborately illustrated and printed on fine paper, will cover new R·A·E stereo and mono kits designs, new kit-building ideas, high-quality installations from the simplest to the most complex, recording techniques, and maintenance and testing methods, with articles on improving reproduction from records, tape, multiplex FM, and TV sound.

The Journal will include an "I Think" department where members will air their ideas as to what they would like or don't like in kit designs, circuits, and methods of assembly. "Notes and Comments" will contain news and criticism related to radio, audio, and electronics. Use of the "Buy, Sell and Swap" section will be available to members without charge.

The wide spread of authoritative, reliable information in the Journal, planned for beginners as well as advanced enthusiasts, is not available from any other source.

R·A·E SOCIETY

Yes, I want to participate in the R·A·E Society's activities. I enclose $1 as my Charter Membership dues for one year. I understand that I will receive a Charter Membership Card, the Quarterly Journal issues for one year, and will qualify to serve on the Advance-Test Panel.

MAIL YOUR APPLICATION NOW:

Use the coupon below or your own stationery.

Name
Street
City & Zone
State

I understand that I am not required to purchase any R·A·E kits to enjoy membership privileges. I am 18 and older.  ( ) Basic 
( ) Advanced

UNCONDITIONAL, MONEY-BACK GUARANTEE: If I am not completely satisfied, I return the charter application within 15 days of receipt, and my membership fee will be refunded promptly on request. No extra charge outside the USA.

R·A·E QUARTERLY JOURNAL

March, 1962

Jo Basile: Jo Basile's Paris

Jo Basile returns from a grand tour of the international scenes to the city of his first success. Mission strings turn off in welcome, swelling the ranks of the little orchestra, a group which supported the leader during his travels. The home-coming party takes place in a spacious ballroom, and the picturesque setting is in sharp contrast to the group's plebeian beginnings. Basile's accordion purrs contentedly amongst the guests, but his may be shipped away to a neighborhood block party to lend the evening in plainer surroundings.

The songs chosen are popular in either place, even a noble visitor from Britain titillates Greensleeves, and includes Gigli, Leo, Ciel To Paris, and Melodie D'Amour. Three Monotet pieces comprise a special treat. Full advantage is taken of the extra personnel to increase the dimensions of the stereo stage, and the strings acquire a romantic bloom in the excellent recording.

The Lime liters: Sing Out!

Elektra EKL215

Bob Grossman

After a series of appearances in packed clubs and radio shows, even the muzzle of a recording studio must seem inviting. Besides, ample proof already exists of the extra dimension that can react with the Lime liters' fly-by, and examples of the sharp advantage is taken of the extra personnel to place, even a noble visitor from Britain also.

Bob Grossman set out on a foil, singing as one in applauding the R·A·E Society idea for people interested in building radio, audio, electronic kits. The Society will help you, too, to derive more enjoyment and satisfaction from this fascinating hobby, and show you how to achieve the best performance possible from kits you build.

The Lime liters...
FAIRCHILD

The same electro-mechanical know-how that for over a quarter century has established FAIRCHILD as a leader in quality components is now available to the astute audiophile and kit builder in a completely ready-to-assemble kit.

FAIRCHILD 412-1K

Turntable Kit

For the astute audiophile who dreams of owning only the finest the famous FAIRCHILD 412 is now available in kit form. The FAIRCHILD 412-1K is identical in assembly to the famous exclusive FAIRCHILD Double-Belt Drive. Comes complete with mounting board. KIT $74.95 Assembled $95.00

FAIRCHILD COMPANDER®

Model 510K

Dynamic Realism in kit form! Through the use of the FAIRCHILD COMPANDER you can now add Dynamic Realism to all your disc and tape recordings. Acclaimed by music and audio experts the COMPANDER restores many of the dynamic values that are necessarily controlled in recording or broadcast. Can also be used as a compressor for background music. KIT $59.95 Assembled $75.00

FAIRCHILD 440-2K

Turntable Kit

This Fairchild single-belt drive, two-speed turntable, 33 1/3 and 45 rpm, has performance characteristics similar to the famous FAIRCHILD 412. This robustly designed FAIRCHILD 440-2K kit with fast speed change, accurate speed control through use of FAIRCHILD Speed Sentinel, unusual low low rumble and flutter makes this a desired addition to any quality component system. Comes complete with mounting board. KIT $58.00 Assembled $69.95

All these FAIRCHILD KITS are available at your audio dealer. Write for complete details.

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You eliminate distortion in even the most elaborate speaker system with a TRU-FI TONE. This easily installed unit (no soldering needed) 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 C.O.D.'s Only $29.55, postpaid. (Calif. residents add 24% sales tax.)

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Circle 59C

AUDIO • MARCH, 1962

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be better than the last and performers leave selling to the doctor in charge.

According to another theory, the trait is regional and helps distinguish the local product from less temperate outpourings usually heard to the southwest. Supporting this claim is the influence of Billie Boy Fuller, who was too fast-releasing the hill country to record with any success. But Fuller had a bad voice, unlike most blues singers, and it had shaped his style, as little restraint shown in the falsetto of Sonny Stitt ano. He native son anymore. Thanks to the efforts of two adventurers with a tape recorder, producers Sam Charters and Ken Goldstein, blues collectors can work out their own solution while listening to Anderson sing four pieces associated with Fuller.

Claude Hopkins: Let's Jam
Prestige/Swingville 2020

Although new material is conveniently separated from swing standards on this album, some finicky listeners may hold an opposite view from the liner notes as to which portion deserves to be called the newer. Actually, the three Claude Hopkins originals prepared for the first side go back further in jazz annals than do the swingers on the reverse. Basic issues are dealt with at the very start, and the quintet gets down to business as Wee dell Marshall ticks off the agenda on 007eat Bluc. With the prompting of drummer J.C. Heard to try on the bassist tells everyone how to time a slow drag for the proper effect. The quest for speed seldom permits today's youthful wonders to work at such a deliberate pace, and they might take a lesson in purity of tone and pertinent phrasing from veterans Joe Thomas and Buddy Tate. Experience on several recent LP's has returned Thomas to his best form, and his trumpet sounds fuller and better than ever. A surprise switch from tenor sax to clarinet has Tate performing like a true son of New Orleans on Late Evening. The interlude should prove pleasant enough to stir up quite a few requests that Tate make the change more often. Each member carries his own weight on Rafter, and the trip across the void is much like the ones Juan Tizol used to plan for Duke Ellington.

Heading the quintet not only gives Hopkins a chance to work his balladic wiles, but his pianistic strength as an accompanist is more evident than during the days when he was leading a big band. He always makes his presence felt, whether by politely nudging the others along or swinging out at will on I Apologize, I Surrender Dear, and his own familiar I Would Do Anything For You.

Don Ellis: New Ideas
Prestige/New Jazz 8257

It was only a question of time before some hapless record company came a cropper with the same reason that an art gallery hangs a modern painting upside down. Everything seems to have gone smoothly with this latest Don Ellis release until the final stages of production, then somehow the sides were reversed. Both the liner notes and labels are correct for the first master number punched on the matrix, but someone blocked out the A and B designations and scratched new letters on the wrong sides. If every collector of curious starts the same routine and outtake for each copy, Ellis may find this inside-out example of damnation not reached by his earlier abstract designs.

Compounding the error is the fact that the first title, Natural II, was selected to show how Ellis handles a familiar line like Sweet Georgia Brown. Apparently the quintet had a few ideas leftover to use on Initiation, which opens the other side, as bits of the theme turn up during improvised solos. The trusting listener can hardly be blamed for jumping to the same conclusion as the expert who switched sides. If any doubts exist after this explanation, the next number is something Ellis improvised in one take at the studio. It is unmistakably an unaccompanied trumpet solo, and the feat should also clear up any doubts about his command of the horn.

Also attempted in one take is an expression of the emotions indicated in the title Despair To Hope, an exercise inspired during attendance at a John Cage concert. Actually, the music is much easier to take than the analysis Ellis gives on the liner, and thinking of it stupidly as a slow blues in which the tempo becomes brighter helps a lot. Ellis introduces a new partner in Al Francis, whose recorded debut on vibes reveals a fresh sounding voice, and the newest thing in fresh rhythm is represented by Jaki Byard, piano, Ron Carter, bass, and drummer Charlie Persip.

INDESTRUCTIBLE?

Not quite. But you might think so if you saw our repair records! E-V professional microphones just seem to keep on going no matter what you do to them.

That's why we can afford to offer an unconditional two year guarantee against failure for any reason. (Just one exception... don't scratch the finish—we charge to fix that!)

Two years is a mighty long time, but E-V also offers a lifetime guarantee against defects in materials or workmanship.

And our out-of-warranty repair charges are the most reasonable in the industry.

You profit every day from the dependability of E-V professional microphones.

Isn't it time to follow the lead of major networks and leading independent studios? Switch to Electro-Voice—dependably better!

Electro-Voice, Inc., Commercial Products Division, Dept. 321A, Buchanan, Michigan

Audio • March, 1962

Jim Copp and Ed Brown: East of Flumm diddle
Playhouse 404
NEW PRODUCTS

- **Thin Speaker System.** Advanced Acoustics announces a new addition to their line of Bi-Phonic Coupler speaker systems. The new unit, called the Wafaire Bio-Phonic, uses a new method of construction which helps improve performance while at the same time reducing cost. The Bi-Phonic coupler does not use cone-type speakers, but instead the wooden panel vibrates as a single piston in an unshunted arrangement. Dimensions of the Wafaire are 12½ x 21½ x 3½. The unusually shallow depth of the system permits it to be placed in a variety of locations not ordinarily compatible to speaker systems. It requires only 10 watts of clean audio power and its impedance is 8 ohms. The Wafaire is available in mahogany, slivered walnut, or lacquered walnut finish. Price is $59.95 individually, or $124.50 for a matched pair. Advanced Acoustics Co., Cedar Grove, N. J. C-1

- **Stereo Preamp.** The new Eico Model ST-84 stereo preamp features distortion levels of 0.05 per cent or less at all levels of all functions. Stylised to match the Eico "New Look" line, its brushed cast-aluminum faceplate is gold anodized with brown accenting band. Input and mode selectors each have seven positions. Switches control low- and high-frequency filtering, equalization of 2½ and 7½ ips tape speed, tape monitoring, and loudness contour. The unit is self-powered. Frequency response is ± 0.5 db from 5 cps to 25,000 cps. Harmonic distortion from 500 cps to 20,000 cps is 0.05 per cent at 2 volts output. Intermodulation distortion is 0.04 per cent at 2 volts output. Tone controls provide 18 db cut and boost at 80 cps and 15,000 cps. Price is $69.95 in kit form and $89.50 ready to play. Eico Electronic Instrument Co., LLC, N. Y. C-2

- **45-Watt Amplifier.** H. H. Scott has made available a 45-watt stereo amplifier kit. The new kit, Model JK-48, includes features such as separate bass and treble controls for each channel, a stereo balance control, front panel tape monitor facilities, and derived center channel output. Although rated at 24 watts per channel, the JK-48 is claimed to deliver 28 watts (IHFM) at low frequencies. For ease of construction the manual shows parts in their actual color. Parts are mounted on separate "Part-Charts," one for each page of the instruction book. All wires are pre-cut and pre-striped. The kit arrives in a "Kit-Pak" container which opens to form a work table. All mechanical parts are riveted to the chassis at the factory. Price of the kit is $124.35. H. H. Scott, Inc., Maynard, Mass. C-3

- **Ride-away Speakers.** Featuring the "reflection coupler" speaker system the Ravenswood M65W speakers are small enough to be hidden out of sight behind a couch, and handsome enough to be in view. The M65W systems in a stereo setup will handle 25 watts of program material and dispersion with the reflectors shown is 180 deg. Impedance is 16 ohms. Each unit measures 29-in. x 16-in. x 6-in. Price for the M65W is $49.95 each in utility black or $54.95 finished in oldied walnut. Ravenswood, Annapolis, Md. C-4

- **FM-Stereo Receiver.** The new Stereo Festival III by Harmon-Kardon, Model TA5000X, is a versatile high fidelity music center for the home. It features separate AM and FM tuner sections for standard broadcast reception, an integrated FM-stereo adapter, two 25-watt amplifiers (music power), and complete control facilities for monophonic or stereophonic listening. The Stereo Festival III includes a d'Arsenal tuning meter, separate tape controls, blend control, stereo indicator lights, front panel headphone receptacle, and an illuminated pushbutton on/off switch. Price of the TA5000X is $299.95. A walnut enclosure is available for $39.55. Harmon-Kardon, Inc., Plainview, Long Island, N. Y. C-5

- **Professional Turntable.** Designed to solve the rumble problem highlighted by the introduction of stereo broadcasting, the Fairchild Model 118 is claimed to be the first 16-in., 3-speed, belt-driven turntable offered to the broadcast industry. Rumble is -65 db below a 1800-eps signal at 5 cm/sec. Wow and flutter are below 0.02 per cent, clearly indicating the advantages of a belt drive. On the other hand, one of the main disadvantages of the belt drive, stretching of the belt, have been eliminated by the use a 2-speed synchronous motor. Also, speed change can be accomplished while the turntable is revolving, and is sufficiently quiet to permit operation very close to open studio microphones. Other features include a 25-lb. aluminum-filled platter and a front dress plate for mounting controls. Semi-automatic operation is available with the use of the new Fairchild "Third Hand," an automatic attenuator. The price of the turntable unit on a top plate is $185.00, and in a cabinet (Illustrated) $350.00. Fairchild Recording Equipment Corp., Long Island City, N. Y. C-6

- **FM-Stereo (Multiplex) Tuner.** Featuring a front-panel switch for the multiplex section, the Lafayette LT-700 includes stereo by means of a front-panel light. The FM circuitry includes a low-noise front end with triode mixer followed by double-tuned dual limiters and a wide band Foster-Speaker discriminator. Separation is given as 35 db at 400 cps and harmonic distortion is less than 1 per cent from 50 cps to 15,000 cps. Overall frequency response is within 1 db from 50 cps to 15,000 cps.

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

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

Export: Moran Exporting Corp., 458 Broadway, N.Y.C.
Prices slightly higher West of Rockies.

www.americanradiohistory.com
The LT-700 is handsomely styled in cream and brushed-brass finish on the front panel and is set in a beige-finish vinyl enclosure. The LT-700 is economically priced at $124.50. Lafayette Radio Electronics Corp., Syosset, L. I., N. Y.

A new level when the input levels shift to a new region. This unit is intended especially for broadcasting, recording, and computer technology, the CBS Laboratories "Audimax" automatic level control incorporates, in addition, a "gated gain amplifier" which maintains a constant gain that bridges the program lapses when the input level drops below a preset level. This unit is intended for FM broadcasters, television, motion pictures, and public-address systems. An Audimax stereophonic adapter is also available to provide for precise stereophonic coupling of two Audimax units. CBS Laboratories, Stamford, Conn.

2. THE AUTOMATIC ARM

A good many years ago, I decided that eventually the phonograph arm was going to get smaller and smaller, as pickup elements grow lighter and more delicate, until it would somehow resolve itself into a purely automatic tracking device—a mini-changer that would eliminate the coarse human hand altogether. Well, it's funny, but it hasn't happened. For one thing (speaking superfluously), the age-old half-inch mounting center for pickup cartridges, dating back to the early crystal period in the 1930's, still sticks with us today, carrying with it the necessity for a large "head" on the arm, its minimum dimensions determined by the need for interchangeability between cartridge models. There are big cartridges and small ones, but all of them to the half-inch line is in this particular respect, except for a few special models that have now and then broken away, such as the Pickering Uni-Boise or the Shure Studio Dynetic. Thus today virtually every arm still has a very swelled head. And a big head tends to require a fairly big arm to support it, if only for looks. Not too many recent arms have sported big heads on spindly "necks," though from an aesthetic point of view the thin-tube type of arm, done right, can be handsome.

Three-Way Designing

The technicians will be screaming at me here that aesthetics come last and what counts isn't arm size at all nor even the head size, but those much more vital basic parameters that go along with all these externals—arm mass, tracking geometry, the asserted weights, drugs and fashions, both vertical and lateral, that must be balanced against the changing mechanical parameters of stylus design within the cartridge itself. Right! I'm not dumb enough to bypass such considerations (out loud!). Nevertheless... the total consideration in an arm does involve three major factors, only one of which is strictly a matter of engineering performance. The pickup arm is designed for people and for the home. Aesthete appeal may be the last factor of importance but it's there just the same, and permanently. And there is that even more important human factor, increasingly our concern these days, the cybernetics of the human arm. Of course the arm must be developed, you see, as part of the human machine with which it will operate; it must be "cooled" to human ergonomics and to human thinking habits. Since we haven't yet been able to redesign the human arm itself, and in particular to miniaturize it, we seem to be more or less permanently stuck with its macro-energy and its relatively coarse movements, as a source of motive power. If you ask me, that is really the basic reason why we still have the big arms and their swelled heads, though I'll admit that the geometry of the 12-in. LP record has a wee bit to do with it.

In a way, you can think of pickup arm design (cartridge types, cartridge suspension, of course) as a kind of constant juggling of various methods of suspension and of motion, to see which one works out best at a given time, for a given set of factors in relation to the unchangeable human being. Remember the 6-oz. RCA magnetic pickups of around 1930 I used one. When those beasts went into operation via the hand the main danger was the needle—and the danger wasn't to the stylus. You could stab yourself 1/2-in. deep
with no trouble at all. You could also stab the record, breaking the point or digging holes. Once on the disc, however, the arm didn't really present much of a tracking problem. It had to track, with all that weight, and no two ways about it, so long as the shellie record was in one piece.

And then there was the first "lightweight" arms, along just before the war. Point pressure was reduced to an excessive lightness—one ounce. I evolved a standard test method for "needle" pressure in those days. Lift the arm by lifting the stylus point with the ball of a finger. If the point doesn't break, the pressure was too great. If it merely pricked a bit, it was all right. You think back over this long period, you find yourself thinking for each arm, none being lighter, until you have come to realize that a lesser weight is more advantageous.

The Grado arm takes all standard cartridges in its tricky bottom-mounted cartridge chassis, made of milky nylon plastic with four delicate fingers for the silver contacts. You place it under the end of the arm and screw it tight upwards via an overhead knob. Good system, though you can't see what you're doing very well, if you ever want to. (Use a dentist's mirror!)

This arm is the most practical and ingenious version of the increasingly popular dynamically balanced arm I have yet run into. For one thing, it is small—unusually so. It fits right into an old changer box of mine—where the last arm I used had to have a hole cut in the side of the box to let its rear overhang out. Short, and also surprisingly simple, considering the variety of adjustments the arm provides. The arm itself is made of wood (walnut, I think), for non-resonance. The rear counterweight is massive and heavy, projecting only a short distance; it slides easily, quite a knurled knob to hold it in place for the fore-and-aft equilibrium that is the special feature of this type of arm. After mounting, and inserting the cartridge of your choice, you first set this rear weight. The cartridge sits in mid-air, balanced. (Same general system on numerous other arms today—Empire, SME, ESL, and so on.)

Then you proceed quickly to the side-wise balance. Grado uses a very simple

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ELECTRONIC ORGAN TONE GENERATORS
(from page 32)


Table 2. Characteristics of typical tone generators.

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This month's cover

The owner of this system, Mr. Francis Colaguori, has combined his two major interests, art and music, in an unusually ingenuous manner. A resident of West Long Branch, N. J., Mr. Colaguori constructed a "picture wall" with the paintings functioning as doors for the compartments in which the high-fidelity components are mounted. He used the following components in his system:

Sherwood S-400 preamp, S-360 basic amplifier (not viable) and the S-3000 III PM stereo tuner (with multiplex)

Telefunken M97 stereo tape recorder
Weathers X905, professional portable and pickup system

Jensen TR10U speaker system (one on pole, the other is out of the picture area)

Another interesting idea revealed by the photographs is the use of egg separators on the surface behind the "wall." We understand they work beautifully as sound absorbers and diffusers.

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HAROLD LAWRENCE

On French Opera, Not Grand

Hector Berlioz called it "music for pastry cooks and dressmakers." Thophile Gautier contemptuously dismissed it as "that wretched bastard form composed of two incommensurate elements, in which the actors excuse their bad acting by saying that they are singers, and sing out of tune on the plea that they are actors."

The target of these and other attacks by 19th-century composers and literary figures was the opéra comique, a peculiarly French institution that is often neither operatic nor comic.

Technically speaking, opéra comique is opera with spoken dialogue. The form had its roots in the medieval "pieces de resistance" and "pièces à rires" of the early eighteenth century, its modern counterpart being the satirical review. Everything not specifically banned by the Court was fair game in these short plays with music: topical events, fashions, the nouveau riches, and celebrated personalities (Cardinal Mazarin was the butt of numerous satires, which acquired the generic title of Mazarinades). From the start, opéra comique, like the gay intermèdes inserted between the acts of serious Italian operas, was essentially a popular entertainment, quite apart from the opera of the "grand" variety, which sets mythological and historical subjects to appropriately dignified music.

The French, who maintain separate operatic and dramatic traditions, have long been seen as the masters of this form. Verdi, who was exiled from his native Italy, came to Paris in 1837 to work on his opera La Damnation de Faust, which was a failure. Verdi left France feeling defeated and frustrated in his attempt to penetrate the confines of French opera, reacting with cold fury to the fluff and frivolity, the operatic nor comic. Berlioz, confronted with defeat and frustration in his operatic career, reacted with cold fury over the easy success of the opéra-comique composers, although he was fair enough to credit some of them with originality and craftsmanship in orchestration.

In recent years, quite a number of lesser known 18th- and 19th-century operas have been revived, either in stage or concert versions. As might have been expected, the majority of these revivals have consisted of obscure works by famous composers, not always a guarantee of high musical quality; e.g., Bellini's Il Pirata. But this operatic archaeological has unearthed some fine music, much of Rossini's Le Due Contesse di Parme and Pizzetti's Barber of Seville. Mid-19th-century opéra comique, however, like Swiss wine, does not export well. Do not blame it on the librettists. Eugène Scribe, who wrote nearly all of Ambroise Thomas's books, was one of the foremost dramatic writers of his day. What of the music? Of minor significance in the history of opera, light in content and treatment, designed
to "gater les bourgeois" (to delight the average Parisian audience)—hardly an unqualified recommendation. Yet, if F. Diavolo is representative of the opéra comique style of the mid-1800's, it would be a pity to banish such music forever. What Rossini wrote of Amber could also apply to the best works of the leading composers in this carefree genre: "He may have produced light music, but he produced it like a great musician."

**LIGHT LISTENING**

(from page 10)

**Living Strings: South of the Border**

RCA Camden CAS 682.

We learn in this release that a "Living Strings" orchestra can be assembled in Mexico just as easily as one in England. This low-priced series (it is listed at a national figure of $2.98) has featured some exceptionally fine performances in the past. Chacho Zarzosa, for instance, the habit as he conducts, in an up-to-date Mexican studio, his own arrangements of Freres, Bessone Mucho, Palucciana and other Hemispheric favorites. There isn't a trace of boredom in the playing of these musicians. They behave as though a sizeable break had come their way in the form of an appearance on a major American label. The quality of the sound in this release is just about on a par with some stereo discs selling at regular prices. Definitely recommended for "budgeted" background listening.

Norman Luboff: Sing! It's Good For You

RCA Victor LSP 2475

Is the Norman Luboff choir being groomed for sing-along releases? Luboff's previous records on this label stressed arrangements that highlighted the virtuosity of the choir. Now we find the chorus occupied with a roster of tunes designed to stimulate listener participation. The mood is resolutely cheerful throughout a lineup that ranges from a Latin combo accompanies MOITand in one of his typical "Happy End." A novelty with an oriental "Goodbye Again." That new woof er may carry the tink l e of temp l e be ll s and at l east one more conviction to the distaff side of the family. In his latest Columbia release, a small amount of reverberation found in some of the more famous sing-a long albums that have come their way in the Mexican studio, his own arrangements of Fren e s i, Besame Mucho, Poinciana and other Hemispheric favorites. There isn't a trace of boredom in the playing of these musicians. They behave as though a sizeable break had come their way in the form of an appearance on a major American label. The quality of the sound in this release is just about on a par with some stereo discs selling at regular prices. Definitely recommended for "budgeted" background listening.

More Yves Montand

Columbia WS 380

Yves Montand has been a Parisian music hall favorite for nearly two decades but his masculine singing style didn't become a major attention on domestic recordings until he made his first American movie. Rele a ses by Montand on French labels first began to catch on among collectors in this country during the Fifties when singers such as Edith Piaf, Patachou, and Jacqueline Francois were demonstrating that Chavalier was not the only French vocal star of our generation. The turning point in Montand's career was the one-man song and dance show he brought to New York in 1959, only to discover that the grapevine in his voice could also be turned to American gold. In his latest Columbia release, a small combo accompanies Montand in one of his typical displays of versatility. There is more than one echo of European music halls in The Bitha Bong from Kurt Wallis' forgotten show "Happy End." A novelty with an oriental theme. From Shanghai to Bangkok, brings in the theme of temple bells and at least one recent movie is recalled in the theme from "Goodbye Again." There are more conventions to the distaff side of the family with this release.

**FREQUENCY RESPONSE**

(from page 28)

Fig. 8. Circuit with high-frequency rolloff.

defined as the time it takes the signal to rise from 10 to 90 per cent of its final value. The passage of time is shown as $t_2 - t_1$ in the diagram.

Just what the relationship is between rise time and the upper frequency limit can be determined from Fig. 8. We can see that the upper frequencies are...
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The equation for this network square wave enters the network shown. The output is 3 dB down when the input is equal to 1. But consider the network as a voltage divider where

$$\frac{e_{out}}{e_{in}} = \frac{1}{R + jωC} = \frac{1}{jωRC+1}$$

The output is 3 dB down when the denominator is equal to $j + j$, or $jωRC = j$. The frequency where the response is down 3 dB is then:

$$ω = \frac{1}{RC} \text{ and } f = \frac{1}{2πRC} \text{ Eq. (12)}$$

Now assume that the leading edge of a square wave enters the network shown in Fig. 5, causing the capacitor to charge gradually. The equation for this network is

$$e_t = V_C + V_R \text{ Eq. (13)}$$

but $V_C = \frac{1}{C} \int i dt$ and $V_R = i R$

therefore $e_t = \frac{1}{C} \int i dt + IR \text{ Eq. (14)}$

A solution to this equation is

$$e_t = E(1 - e^{i10/2}) \text{ Eq. (15)}$$

where $e_t$ is the instantaneous voltage across the capacitor at any moment of time after the leading edge of the pulse has been applied, $E$ is the final voltage after an infinite time, and $i$ is a constant equal to 2.72. We can now find the time it takes for the voltage to rise from 10 to 90 per cent of its final value.

For convenience, let us assume that $E$ in Eq. (15), the final voltage across the capacitor, is 1. At the 90 per cent portion of the final voltage, $e_t$ must be equal to 0.9. Substituting these into Eq. (15),

$$0.9 = 1(1 + e^{-10/2})$$

Putting this into logarithmic form gives

$$\log \frac{0.1}{0.9} = -10/2$$

$$-RC \log \frac{0.1}{0.9} = t = 2.3RC \log \frac{0.1}{0.9}$$

$$t = 2.3RC \log 1.9 = 2.3BC \text{ Eq. (16)}$$

The time that the voltage to reach 10 per cent of its final value, can be found by substituting 0.1 for $e_t$ in Eq. (15),

$$0.1 = 1(1 - e^{-10/2})$$

Putting this into logarithmic form gives

$$\log \frac{0.9}{0.1} = -t/RC$$

$$-RC \log \frac{0.9}{0.1} = t = 2.3RC \log \frac{0.9}{0.1}$$

$$t = 2.3RC \log 0.9 = 2.3BC \log 1.9 \text{ Eq. (17)}$$

The time required for the voltage to rise from 10 to 90 per cent of full value is the difference between Eq. (16) and (17).

$$\text{Rise Time} = t_2 - t_1 = (2.3 - 0.95)RC$$

The frequency where the response is down 3 dB is then:

$$f = \frac{2.2}{\pi t_2} = 0.35 \text{ Eq. (18)}$$

Equation (18) will yield the 3-db point for frequency response at the high end. This equation will give the 3-db point from actual measurement, whereas Eq. (12) will give the point from component calculations.

Unfortunately, the rise-time measurement cannot be readily made on all oscilloscopes found in the average laboratory: it must be made on scopes in which the horizontal axis has been calibrated in time. Only on these more expensive types of equipment can this test be made accurately.

While on the topic of oscilloscopes and square waves, it should be noted that not all oscilloscopes are capable of properly reproducing square waves. Whole-band d.c. scopes best suit the task of observing all kinds of square-wave responses.

### Measuring Preamplifiers

In general, the test procedure and setup for measuring a preamplifier is identical to that shown in Fig. 4. One important exception must be considered. A 16-ohm load has been placed at the output of the power amplifier. This is an extremely low impedance. Any normal capacitance due to instruments, such as the a.c. voltmeter, oscilloscope, distortion analyzer, and so on, is negligible.

The output of a preamplifier is usually high impedance. The capacitance due to the instruments as well as the connecting leads may have a considerable effect on the frequency response. For this reason all instruments not actually involved in the test should be disconnected. The connecting leads should be made of low-impedance single-conductor shielded cable, and kept as short as practicable.

Frequency response is an extremely important characteristic of an amplifier but it should be considered in its true perspective. Just as a wide frequency response does not necessarily indicate an excellent unit, a limited bandwidth does not necessarily indicate a poor amplifier. Bither extreme can be a detriment as well as a benefit. A good design involves all factors and the best compromise is achieved only after everything involved
in proper audio reproduction is considered.

**APPENDIX**

Repeating Eq. (14):

\[ R \frac{1}{C} \int_{0}^{t} \frac{1}{C} dt = \varepsilon \]

The complete solution involves both the steady state and the transient solution. The force-free transient force-free solution can be found by setting \( \varepsilon = 0 \), resulting in:

\[ R \frac{1}{C} \int_{0}^{t} \frac{1}{C} dt = \varepsilon \]

**Assume \( i = A e^{it} \)**

Eq. (14B) as a solution to Eq. (14A). Substituting gives:

\[ R \frac{1}{C} \int_{0}^{t} A e^{it} dt = 0 \]

Solving for \( \varepsilon \) results in:

\[ \varepsilon = \frac{A}{R} \]

Substituting this into Eq. (14B) leaves as the solution for \( i = A e^{it} \)

At the start of the impulse, all the current is across \( R \). The current through the resistor at this instant is \( I = \varepsilon / R \), resulting in:

\[ i = A e^{it} \]

Eq. (14C)

The steady-state solution for this is \( i = 0 \), the transient solution for the voltage across the capacitor is:

\[ \varepsilon = \frac{E}{C} e^{-\frac{t}{RC}} \]

Eq. (14D)

When \( t = 0 \), \( E = 0 \). At this time, Eq. (14E) becomes

\[ \varepsilon = \frac{E}{C} e^{-\frac{t}{RC}} \]

Eq. (14E)

Which is Eq. (15).

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**TelePrompter Purchases Weathers.** As its first entry in the high-fidelity components field, TelePrompter Corp. announced the acquisition of Weathers Industries of Barrington, N. J. TelePrompter Corp. specializes in audio-visual and electronic communications equipment and services. Irving B. Kahn, President of TelePrompter said that "Weathers fits perfectly into our plans to develop and market an expanded line of audio-visual products. We intend to maintain the high quality of Weathers products and to augment the line with items now being developed in our laboratories." Gerald G. Griffin, TelePrompter Corp. Vice-President of Marketing, etc. that they plan to offer their audio-visual equipment through distributors already handling Weathers products and, in addition, will develop new outlets throughout the United States and abroad. Weathers Industries will be operated as a separate division of the TelePrompter Corp. with Mr. Paul Weathers as Director of Engineering.

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