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DYNAMIC MASS
less than $5 \times 10^{-3}$ gms

PERFORMANCE RANGE
6 to 30,000 cps

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*Patent Pending

EMPIRE SCIENTIFIC CORP., GARDEN CITY, N.Y.—WRITE FOR LITERATURE

CREATORS OF THE EMPIRE TROUBADOR... WORLD'S MOST PERFECT RECORD PLAYBACK SYSTEM
SHERWOOD

only for those who want the ultimate

S-8000 FM/MX 64-watt Stereo Receiver $299.00.
16 1/4” x 4 5/8” x 14” deep. Combines Sherwood’s brilliant FM stereo tuner design, two 32-watt amplifiers, two phone/tape pre-amplifiers, and all circuitry necessary to receive FM stereocasts.

RAVINIA Model SR3-3-way speaker system $129.50. Walnut Cabinet 26 1/4” x 15” x 13 1/2” deep. 12” high-compliance woofer, 6” midrange, and 2 3/4” ring-radiator tweeter. Features low intermodulation distortion. Flat frequency response (+5/0.5 dB) to 17 KC.

S-8600E FM/MX stereo Tuner $400.00. 14” x 4 5/8” x 10 1/2” deep. Identical tuner design to S-8500. Other tuners: S-7100 FM Stereo/AM Tuner $199.50, S-7900 FM/AM Tuner $150.50. (Same but without FM stereo feature)

FM Stereo Multiplex Adapters may be used to convert Sherwood and other FM tuners for stereocast reception. $49.50 to $69.50.

S-5500 FM 64-watt Stereo Preamplifier-Amplifier $154.50. 14” x 4 5/8” x 12 1/4” deep. Identical to amplifier used in S-8500. Other amplifiers: S-5000 80-watt Stereo Amplifier-Preamplifier $199.50.

This typical room setting includes Sherwood’s Super Stereo Starters—a one S-8000 Receiver and two SR3 Loudspeakers. Sherwood Electronic Laboratories, Inc., 4300 N. California Ave., Chicago 18, Illinois. Write for complete technical details.

LEAK "Sandwich" Speaker 36
Pickering Stereo Cartridge 38
Knight-kit Automatic A.C. VTVM 38

Audio in General

Joseph Giovanelli
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Leak "Sandwich" Speaker 36
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Audio Articles

H. Heinz
North C. Han
George Fletcher Cooper
R. S. Oakesley, Jr.
R. Katz

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Electrolytic Capacitors

Q. In amplifier power supplies (conventional RC type—no choke), is there any objection to using much larger capacitors (approximately 200–400 µf) than the 50–to 50-mf capacitors usually indicated for 20–to 50-watt amplifiers? Wouldn't they provide much better voltage regulation when peak power is required momentarily for low-frequency transients.

A. There is no objection to the use of larger filter capacitors in a power supply, provided the rectifier can take the current surges which such capacitors will cause to flow. A small resistor placed in series with the cathode of the rectifier and the input filter is usually sufficient to hold down the effect of such surges to safe levels. Values for this surge-limiting resistor range from 5 to 50 ohms. Ten-watt ratings are often required.

You would not find such large amounts of filtering used in the moderately-priced commercially-made amplifiers because of the need for economy and the need for a small package.

There is no need to increase the size of the decoupling capacitors over their present levels in most instances because they provide a very low-reactance path to ground for the low frequencies. You only need a capacitance of 4000 ohms when the value of the decoupling resistor is 20,000 ohms in order for decoupling to be effective. The rule usually cited is that the reactance of the decoupling element in an amplifier should be 1/5 the value of the decoupling resistor, which, in turn, should have a resistance of at least 1/5 that of the plate resistor. Thus, for a plate-load resistor of 100k ohms, the decoupling resistor would have a resistance of 20k, and the capacitor associated with this network would have a reactance of 4k ohms at the lowest frequency in which we are interested, or, in other words, at which the circuit is to be used.

This ratio is also the one which should be used with cathode resistors. Again, it should be chosen so that the reactance of the capacitor has the proper reactance at the lowest frequency at which the circuit is to be used.

However, when an output stage is under consideration, there is really no need for a capacitor because of the cancellation which is produced by the push-pull action of the stage. I referred to output stages because they are the most commonly encountered push-pull stage, but what holds for this stage regarding cathode bypass capacitors also holds for any push-pull audio stage.

The frequency upon which reactance calculations of this type are based is usually 20 or 30 cps.

Standing Waves

Q. Why are standing waves in either the listening room or in the speaker enclosure harmful to faithful reproduction of music? If they are standing, how can we hear them? Are they harmful even if we could not hear them? Suppose they were of very low frequency so to be out of the range of audibility. Don't standing waves exist in the original concert hall or recording studio? Cyril M. Gaydos, Philadelphia, Pennsylvania.

A. Standing waves are nothing in themselves. I say that because you said they might be of such a low frequency that they could not be heard. In other words, if there is no sound present in the room, there can be no standing waves.

Let's start from the beginning. You know that sound is transmitted in the form of waves which impart motion to air molecules. These, in turn, impart motion to adjacent particles of air, and the waves radiate in all directions from the sound source. This is what happens out-of-doors or in rooms which are specially designed, where there is nothing to reflect the waves back to the sound source. Indoors in recording studios the walls are so padded with sound-absorbent material that bound can't be reflected back to the source of that sound to any appreciable degree. (By arranging the amount of such sound-absorbent material in the right proportions and composition, it is possible to achieve a particular acoustic quality which might be required for a particular kind of recording characteristic.) Let's take the ordinary living room. The four walls are parallel to each other and are made of hard material, often with not even a curtain to act as a sound absorber. (Recording studios are some-
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Have you an AM or FM radio, or a TV set? If so, you can tape music and variety programs being broadcast every day—or, for that matter, borrow your friend's records and put them on tape. You'll pay for your tape recorder with the money you save on records—one inexpensive 1200 foot reel of high fidelity Tarzian Tape holds a full hour of music recorded at 7½ i.p.s.

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**AUDIO** • JUNE, 1962

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times constructed so that no two walls are parallel. Further, the floor and ceiling are parallel. The floor, of course, is usually padded by virtue of the carpeting and its underlying protector. (Ozite carpet protectors are very fine sound absorbers, and are sometimes used as the lining inside loudspeaker enclosures.) Let us say that sound is transmitted from one wall and travels to the opposite wall. This sound is a regular sinewave; perhaps generated by an audio oscillator, so the waves just keep coming along one on top of the other. The sound finally reaches the other wall and bounces back as though the wall was a mirror. However, the sound is still coming forward from the sound source. What happens when the two waves collide is the effect we call standing waves. If the phase of the reflected wave is correct, it will reinforce the original wave and the apparent signal is louder than it would be had there been no reflected signal added. At some other frequency transmitted by the generator or at another part of the room, the phase may be reversed so as to cancel the sound almost completely. The phase may be somewhere in between these extremes. Not only will the effect depend upon the frequency of the waves, but it will depend upon the position in which the listener is located in the listening room. The exact relationship between the two sets of waves (those transmitted and those reflected) will vary in different parts of the room. This is obvious when you stop to think of it. This, then, is what is meant by standing waves and their effects. They are of such magnitude in the average listening room that it is impossible to take a meaningful frequency response of a speaker or of a microphone. Music may sound boomy or it may seem to lack lows or may seem too shrill. (This is one good reason tone controls have been incorporated into virtually every home music system. Use them to help compensate for poor acoustical conditions within the room.) The sound from the speaker will vary as has been said, depending upon the position occupied by the listener in the room.

The explanation of standing waves presented here was over-simplified. Remember that we said that sound travels in all directions from the sound source; a threedimensional wave. Some of the sound will strike the ceiling or floor and reflection from these sources will also take place.

Much the same action as has been described for a listening room can exist in a loudspeaker enclosure. Sound leaving the rear of the cone and striking the rear panel of the enclosure can be reflected back to the cone in such a manner that some of the signal will be cancelled (or reinforced). If the listening room or speaker cabinet is such that the effects of standing waves are only present at frequencies below the range of hearing, their effects would not be noted aurally.

This is not to say that standing waves are the only factors which play a part in degrading the sound in the listening room or in the speaker enclosure. Air resonances in the room or panel resonances will set up strong sound wave transmitters at certain frequencies. These will also be reflected and added to the general confusion, lending their voices to the general confusion.
THE REMARKABLE NEW AWARD KITS BY HARMAN-KARDON

The perfect blend of form and content. This is the unique achievement of the Award Kit Series.

There's sheer pleasure in just looking at the kit: in seeing how each component is packed precisely in the sequence in which it will be used; how the unique tool-box packaging, with pull-out trays, makes handling and identification easy.

An extraordinary instruction book lends a dimension never before available in a high fidelity kit. It contains simple, interesting explanations of how each section of the instrument works. For the first time the kit builder understands just what he is doing—as he is doing it. The handsome book is easel-, spiral-bound and provides complete integration of diagrams and text.

No detail has been overlooked in the creation of this exciting product group. Here is the electronic perfection and incomparable performance of the famed Award Series; the total integration of the most advanced instruction material, packaging and construction techniques. From the moment you open the kit, until the final moment when the completed instrument is turned on, yours will be a totally gratifying experience.

The Award Kits include: Model A30K—handsome 30 watt integrated stereo amplifier kit—$79.95. Model A50K—powerful 50 watt integrated stereo amplifier kit—$119.95. Model F50XK—professional FM Stereo (Multiplex) tuner kit—$129.95. All prices slightly higher in the West.

LETTERS

Hi Fi is Older than AUDIO

SIR:
You may be horrified to know that nearly twice 15 years ago, hi fi was already in being in England, and the course then started would no more have led to great advances had not Hitler walked into Poland in 1939 and provided Britain with a more important task than leading the world in hi fi for the home.

As my business is no longer operating, literature we issued pre-war no longer counts as commercial publicity. Instead it has become historic. The particular folder enclosed herewith was issued in September, 1937. However, even then it was a reprint of earlier editions. The actual instrument illustrated on the front cover was the one which, in the summer of 1935 was specially "dressed up" for our demonstrations near Radiolympia (the annual radio show) and that was 6½ years ago!

At that time, the internal structure was similar to that reviewed in the December 25, 1934 issue of the Wireless World.

P. G. A. H. VOIGHT

Additional Pioneers

SIR:
The high-fidelity industry owes you a vote of thanks for your splendid article, "Audio Pioneers," which appeared in your magazine of May 1962. I realize that you could not not include all of the great names from years past and present in your article, but my hat is off to three pioneers that I feel should have been mentioned. Saul Marantz, Stewart Hageneman, and Herbert Keroes. They are all great in my book.

LEON KUNY
Sales Manager, Harman-Kardon

(They are great in one book too! Actually we asked more people than finally appeared—some were unable to get photos and such to us in time. Ed.)

THIS MONTH'S COVER

The system shown on the cover is comprised of a Fisher 101R stereo tuner; a Marantz stereo preamp; two Dynakit Mark III, 60-watt amplifiers, driving four AR II speaker systems. The turntable is a Thorens TD 154 with an Audio Empire tone arm and cartridge. The tape recorder is a Concertone, Model 655, and the cabinets were made to the owner's specifications by Handloser Custom Cabinets of Burbank, California.

The setup also consists of a few extras such as a patch panel and a balance meter located below the preamp. Located below the tape recorder is another panel with two VU meters used for recording. The system has a modified Fisher reverb unit which is not seen. An electric clock is located below the turntable.

The proud owner is Greg Venable of Burbank, California.

One High-Fidelity Technical Society?

SIR:
In reading the qualifications of many of the industry leaders in your Audio Pioneers section of the May issue, I note that they are members of the IRE, AES, HFM, Acoustical Society of America, AIEE, MRIA, SMPTET, and others, not to mention European organizations. While these organizations deal with many problems related only to their particular field, the technical work in the high-fidelity field is widely scattered. Would it not be possible to consolidate all technical groups working on high fidelity under one roof?

I am looking forward to the 30th Anniversary Issue of Audio, although I am not sure whether it is going to be received as a magazine, or as a roll of tape!

JOSEPH N. BENJAMIN
President
Benjamin Electronic Sound Corp.

(We agree, it would be valuable to have one society concentrating on the technical problems of high fidelity. How about the IIFM or AES? Ed.)

He's for Audio Clubs

SIR:
Your editorial comment on "Audio Clubs" interested me immensely. I believe in this principle of unity among true audiofans not only, as you have stated, for "comparing, sharing and learning," but most importantly, to educate members and future participants in the true concept of high fidelity.

I am sure audio clubs will benefit not only the members, but also the manufacturers who honestly produce and distribute reliable high-fidelity components. I will be very happy to act as a central point for the Westchester County and upper Bronx area.

PATRIZIO ROSSI,
39 State Street,
New Rochelle, N. Y.

LAST MONTH'S COVER

In the hustle and bustle of putting together our May issue, we neglected to give some vital information about the cover: the photographer and the how.

For those who require photographs of lyres, our photographer was C. G. McProud.

As explained to us, the crystal lyre was photographed against a background of green velvet which required several hours of browsing to select. (The velvet wasn't hard to find, but he likes to brown.)

The lyre was placed on a cardboard base which had a hole cut just below the lyre, and then the velvet—also with a hole in it—was artfully draped around it. The light from a Sylvania Sun Gun was then directed up through the hole in the base, thus creating the internal reflections which make the photograph so interesting. Another Sun Gun provided fill lighting.
The corporate charter of Acoustic Research, filed in the Massachusetts State House, states the purpose for which AR was founded:

"To engage in research, development and manufacture ... in the field of acoustical, electronic, electrical, and mechanical engineering and devices:"

AR now introduces its first product outside of the loudspeaker field. The AR turntable cannot be used for records other than 33⅓ rpm, and its starting time is not short enough for cueing applications. Apart from these qualifications, its performance should be judged by professional standards and on an absolute basis, without consideration of price.

**Stable** performance. The suspension design makes it possible to deal a moderate hammer blow directly to the top plate without making the needle jump grooves. This is not a recommended procedure, but it does serve to demonstrate the turntable's insensitivity to floor stomps or to acoustic feedback.

**Complete** (except for cartridge) including arm, cables, oiled walnut base, transparent dust cover, and even needle force gauge and overhang adjustment device. Overall dimensions with the dust cover are 12¼" x 16¼" x 5½".

**Professional** quality. The AR turntable is guaranteed, as a condition of sale, to meet NAB specifications for broadcast equipment on wow, flutter, rumble, and speed accuracy. The 3.3 lb. machined, individually balanced aluminum platter is belt-driven from synchronous motors.

**For Buttermakers**. This is a picture of the tone arm a second after it has been "accidentally" dropped. It floats down to the record, yet as soon as the needle touches the groove the damping is released and the arm is freed of restraint. Needles and records are protected against predators.

The AR turntable is sold under a one-year guarantee that includes parts, labor, and reimbursement of any freight to and from the factory. It is on demonstration at dealers' showrooms and at AR Music Rooms, on the west balcony of Grand Central Terminal in New York City, and at 52 Brattle Street, Cambridge, Massachusetts. No sales are made or initiated at these showrooms.

$58.00

**Less Cartridge.**
The material on this tape has enjoyed a distinguished career annoying the wives and spouses of some and stereo companies. When they first appeared on the Audiophile label in the late '50's, this thunderstorm in the Round became part of the standard procedure wherever good sound systems were subjected to severe listening. This remedial procedure was tried by several conventional stereo systems in the early '60's and continues to be a standard part of the repertoire of some of the more extreme (and often noisy) stereo enthusiasts. It is not a matter of taste, but rather a matter of necessity, for it is not easy to get full high-end reproduction out of a conventional stereo system. Without the extreme high end and all that goes with it, the music does not sparkle the way it should. The result is a music that is not as interesting as it should be, and one that is not as exciting as it should be. The extreme high end is necessary to bring out the full potential of the music, and without it, the music is not as good as it could be. The extreme high end is necessary to bring out the full potential of the music, and without it, the music is not as good as it could be. The extreme high end is necessary to bring out the full potential of the music, and without it, the music is not as good as it could be. The extreme high end is necessary to bring out the full potential of the music, and without it, the music is not as good as it could be.
How to test a stereo kit for top performance:

Simply look for this name.

You don’t even have to open the box. If it’s a Fisher Strata Kit, you already have better proof of performance than if you had built any other manufacturer’s kit and tested it in one of the world’s most elaborately equipped audio laboratories.

How can Fisher make this claim? Very logically. Fisher has one of the world’s most elaborately equipped audio laboratories. Fisher did build and test everyone else’s kits before the Strata Kit engineering program was finalized. The task then set for Fisher engineers was to outclass in every way what they had found in other designs. Which they did. They drew on all the knowledge accumulated in the course of 24 years in high fidelity and the results are in the box. Strata Kits are easier to build than others, the Strata Kit instruction manuals are clearer than others, the completed Strata Kits have more advanced features and perform better than others. And we have yet to hear of someone who could not complete his Strata Kit successfully and with the greatest of ease.

The Fisher Strata Kits now at your dealer are the KX-200 80-watt stereo control-amplifier and the KM-60 FM Stereo Multiplex wide-band tuner. Both sell for $169.50. Both are the world’s finest in their class. The proof is simply in their name.
THEORY BECOMES REALITY
the first loudspeaker ever with true PISTON ACTION

the new, dynamic LEAK "SANDWICH SPEAKER"

Historically, the moving-coil loudspeaker was invented in 1925. Ever since then, engineers throughout the world have feverishly sought for a loudspeaker which can operate in the manner of a TRUE PISTON.

After a decade of intensive research by the undaunted British engineering team of H. J. LEAK & CO. LTD., the first really new invention in loudspeakers since 1925 is now a reality.

The LEAK PISTON-ACTION SANDWICH SPEAKER SYSTEM is a revolutionary milestone in sound history. Its unique "sandwich" cone, constructed according to aerodynamic principles, operates in TRUE PISTON-ACTION without the slightest buckling or flexing — resulting for the first time in the absolute of transient response — NO PEAKS, NO TROUGHS, NO "BREAKUP DISTORTION!"

Your examination of this new, dramatic breakthrough in design—its technically sophisticated construction and engineering—its tremendous, vibrant and true tones—will convince you...it's the speaker system worth waiting for.

Though, the LEAK SANDWICH SPEAKER has won with "flying colors" all laboratory tests...you should listen to it under room conditions...it was designed for the home. Hear it demonstrated in "the listening room" of your LEAK franchised audio specialist.

HEAR ME! HENRY Mc SHERRY—HAROLD FORBES bring to life the world's most celebrated recordings on Hi-Fi Stereo LP's.

LEAK RESEARCH - ENGINEERING - MANUFACTURING


continued on page 51

AUDIO • JUNE, 1962

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another REKO-KUT exclusive!
NEW RONDINE 2

the only single play turntable with fully automatic operation

REKO-KUT, maker of the world's finest turntables, combines the superior quality of single play turntable with Auto-Poise—the first motor-actuated tonearm. To achieve this unique record playback system, REKO-KUT designed this unit with two motors, each of which performs separate functions. One motor drives the turntable quietly at a constant, accurate speed. The second motor actuates an electromechanical device which, at the press of a button, places the tonearm on the record at one gram force, removes it automatically at the conclusion of the recording, returns it to the arm rest, and shuts off the turntable. From the first groove to the last groove of your record, Auto-Poise is disengaged and the tonearm is completely free-floating and independent. If you want turntable perfection, distinctive styling, unequaled engineering and workmanship in a single compact factory-assembled unit (14½" x 14½") that will fit any cabinet, then the RONDINE 2 is for you. Ask your dealer for a demonstration or write for free descriptive literature.

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

REKO-KUT COMPANY, INC.
38-19 108 ST., CORONA 68, N.Y.

AUDIO • JUNE, 1962
More Background on Phones

1. MULTIPLE LISTENING

I left a note on my desk for my assistant a few weeks ago that expressed the thought which stimulates this month's subject. "Earphones are still hot," I wrote as I put him back to work on more earphone connecting plugs and four-wire cables.

They definitely are still hot and getting hotter. In the months since my last venture into the area I have learned a good deal more about them, collectively and individually, thanks to the manufacturers, who have increasingly had me by the ears both plugs and four-wire cables.

Indeed, one evening a week or so ago I was arranging a telephone call. I had three sets of phones on my head at once, Arveyes, was an early radio enthusiast and took a death grip on my adam's apple. I have, on other occasions, been so entangled in phone cords that it took me a good five minutes to stand up for a mere trip across the room.

No, multiple "phone listening" is not a very practical hobby. On the other hand, phones for two or three persons, or even five (with a bit of coarse-planning for the cables) is most sociable and indeed lots of fun, in a curious new way. I do sincerely know, from personal experience, that though the two (or more) phones are exclusive to the outer ear, the blending is ultra-simple, though relatively few people have applied it systematically and with understanding. Blending mix the two channels partly together.

Don't think it is a simple thing, this blending. The actual operation of the blending process upon the ears via phones has had me so bemused that I now up a 12-page predecessor to this article, delayed the magazine almost two weeks, and am still fussed and confused by the implications of what I've been observing in the blend process. For the very fundamentals of hearing and of binaural perception, and of the complex phenomenon of stereo sound, are here involved to an astonishing degree.

LOADSPEAKER BLEND

The stereo blend control (or separation control, if you think of it the other way round) merely adds channel A and channel B together, not all at once but in graduated proportions, or in a continuously increased overlapping. (Both types of control are common.) If I'm right, these controls generally would increase proportionately one channel into the fixed volume of the other rather than go in for a more involved blend that would actually overlap each channel with the other in both directions.

Whatever the system, the stereo result that is, with loudspeakers—is to decrease the spatial separation, progressively or by steps, to compress the heard image towards the central point between speakers, adding phone effect, non-commercial, (with stereo spread, until full blend is achieved with the channels in full parallel. Given proper phasing (we take that for granted—but wait an ear can never tell or tell of individual phone systems . . . ), then we have a mono signal, emerging from the central point between your two stereo speakers.

PHONE BLENDING

Now the tricky part begins when you consider the earphone situation from the point of view of the blend. First of all, you have to understand that the effect is remarkably different from that with loudspeakers.

Actual distinction is one we are always forgetting. Stereo for speakers is intended to be heard so that both ears receive both channels. That's where the loudspeaker placement comes in. Listener A is heard off to the left, via both your ears. Speaker B is located to the right, via both ears. The stereo miracle is in fact, from the two points of spatial information we derive the par-physiological, part imaginative "stereo cur- tain of sound," spread out from side to side. In earphones, for two phones, it has to be said once more, stereo channel A goes only to one ear, the left ear. Channel B by itself, then, cannot be heard, though it is "on" but reaches the right channel B, which is exclusive in the right ear.

Play your two channels alone one after the other in two speakers and each has its spatial location, via two ears. Play the same two, one after the other in phones, and each one is "inside" its own ear, seemingly at a point on the ear itself.

Moreover—and here is a crucial point—these sounds that are heard in one ear alone have a peculiarly distorted effect, even though in actuality they may be clean as a whistle. One-ear sound apparently is repugnant to the human nervous system, which cannot adapt as well to one ear alone as it can with two ears—a miracle. You can test this for yourself easily enough. Play a good signal into a pair of phones and fade out one channel. With both channels audible (mono or stereo) the sound is pure and natural, as good as the "if" of the system allows. But when one channel is silent, instantly the remaining ear hears a loud, jangling, semi-unintelligible noise, horribly distorted. Fade back the second ear and instantaneously both ears hear good sound.

Note a further crucial point. Though balance in level between channels is pleasing, you will find that the earphone channels remain undistorted even with an imbalance between the channel levels—so long as the two ears have at least a shred of sound to
A great tape recorder made greater:

1. New professional studio recording hysteresis-synchronous capstan motor: 24 stator slots for ultra-smooth drive, ultra-quiet and vibrationless professional bearing system.
2. New take-up and rewind reel motors, both extra-powered for effortless operation.
3. New cored-out steel capstan flywheel with all the mass concentrated at the rim for improved flutter filtering.
4. New optimally designed capstan drive belt brings wow down to negligibility.
5. New relay provides instantaneous extra power to the take-up real motor at start to minimize tape bounce. Provides near-perfect stop-and-go operation and eliminates any risk of tape spillage when starting with a nearly full take-up reel.
6. New automatic end-of-tape stop switch cuts off take-up reel motor power. Also permits professional editing techniques, whereby tape being edited out runs off the machine while you are listening to it.
7. Playback preamps remain on during stop-standby mode to permit cueing.
8. Recording level adjustment during stop-standby.
9. Shock-absorbent helical spring tape lifter practically eliminate tape bounce at start of fast winding.

And All These Well-known RP-100 Features:

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

Wow and flutter: under 0.15% RMS at 7½ IPS; under 0.2% RMS at ½ IPS. Timing Accuracy: ± 0.15% (±3 sec in 30 minutes). Frequency Response: ± 0doh 30-15,000 cps at 7½ IPS, 55db signal-to-noise ratio; ± 20doh 30-10,000 cps at ½ IPS, 50db signal-to-noise ratio. Line Inputs Sensitivity: 100mv. Mike Inputs Sensitivity: 0.5mV.
The Canby Formula for practical phone listening is simple. The Ninety Per cent blend. Its explanation isn't so simple; but the fact that it works is not beyond understanding. For the best possible stereo earphone listening, blend the two channels almost all the way. No less.

On step-type blend controls, use the position nearest full mono. On continuous-blend controls, turn all the way around to mono, where the sound suddenly thins out, due to the confusions of your cranial, then back off just a bit—you'll discover immediately (as per the above) that the difference between the sounds reaching each ear is enough for the ears to work on effectively as a team. Here, again, the ears grasp towards their normal function, clinging to the tiniest traces of what they want, make much out of little. So—a minimum amount of "unblending."

The maximum observed "size" in the sound seems to be a super-logarithmic here. Almost the entire sense of space inherent in the recording is achieved in the first small increment of unblending. The rest merely adds more spatial exaggeration.

Two-Eared

Blending, you see, removes all the one- eared sounds. With partial blending of the channels, every sound that is uniquely in one channel of the recording is given a mate in the other ear, at a lower level, with which it may fuse. Thus the highly- unpleasant-seeming distortion and unpleasant feeling of Cotton balling fit into that ear. But no change of location.

The Unfused Mixture

There you have the observable background for the special phenomenon of earphone or binaural stereo listening. It is fundamentally different from loudspeaker listening. In straight, unblended form it is generally unsatisfactory, because it is variably and distantly false to the intentions of the stereo recording, where both ears always hear both channels.

The worst part of straight stereo via earphones—except in those comparatively few M-S or cross-miked stereo recordings where the two mikes (only two) are placed close together—is the relatively large proportion of one-ear sound, mixed in with sounds which are stereo-eared, which can be grasped by both ears and fused together, like the pairs of pictures we fuse with our two eyes.

One-ear sounds, as we've already seen, are unacceptable to our hearing system and produce unpleasant-seeming distortion and ear-fatigue. Note, now, that they are just as unpleasant, just as fatiguing, when heard mixed together with two-ear, fusible sounds. That's what most stereo recording gives us via phones. A mixture, many sounds that are easily fused for a common perception, but many more, in various subtle ways, which are impossible to hear and fuse via both ears. They appear in one channel only; or their "opposite number" in the other channel, due to extreme microphone differences, is so out of whack, so different, as to be unfusible.

Stereo Blend

And so, finally, we come to the phenomenon of earphone listening to stereo and the second practical solution, in lieu of the ingenious Bauer circuit—that of simple channel blending.

The Canby Formula for practical phone listening is simple. The Ninety Per cent blend. Its explanation isn't so simple; but the fact that it works is not beyond understanding. For the best possible stereo earphone listening, blend the two channels almost all the way. No less.

On step-type blend controls, use the position nearest full mono. On continuous-blend controls, turn all the way around to mono, where the sound suddenly thins out, due to the confusions of your cranial, then back off just a bit—you'll discover immediately (as per the above) that the difference between the sounds reaching each ear is enough for the ears to work on effectively as a team. Here, again, the ears grasp towards their normal function, clinging to the tiniest traces of what they want, make much out of little. So—a minimum amount of "unblending."
The small, light RM-6
Though it weighs only 1.7 lbs., is only 12" long complete with its high performance dynamic microphone, and can easily be handled with one hand, the RM-6's performance matches much larger megaphones. Your voice will carry as far as 375 yds. clearly, pleasantly, without howl.

The outer casing and horn are made of a light, strong synthetic resin. Thus there is no danger of breakage, rusting or corrosion. Priced reasonably, this model RM-6 marks another outstanding contribution to the world of sound by PIONEER.

The versatile RM-5
With 4 transistors and a 5-watt output, the RM-5 is light enough to be carried by a shoulder strap and fine enough for mounting in a meeting hall. It can be connected to a record player or a radio tuner and operated on an outside power supply such as a 12V battery. Its clear, rich sound comes from such features as its attached dynamic type microphone and its OTL (output transformer-less) system. A truly versatile megaphone.
EDITOR'S REVIEW

ONE YEAR LATER

It was precisely one year ago that Audio presented the first crop of articles about the newly-accepted form of stereo broadcasting, multiplexed FM. At that time there was both enthusiasm and apprehension voiced—enthusiasm for the music potential of airborne stereo, and apprehension lest haste in bringing products to market make waste.

Well the fears have been laid to rest by now and FM-stereo broadcasts are being enjoyed by ever-increasing audiences. The heroes in this tale are most assuredly the equipment manufacturers for solving so many sophisticated technical problems so rapidly, and with nary a false start. The feat is really remarkable when one considers that the changeover took less than a year, and that in that year existing equipment was adapted and that sets with built-in multiplex have been available in profusion for a good many months.

What is even more remarkable was the lack of confusion and turmoil in the transition. Thinking back about the introduction of the stereo record, and the absolute chaos that resulted, one can only marvel at the matter-of-fact way that the advent of FM stereo was handled. Of course we mean matter-of-fact as compared with the introduction of the stereo record. For which we say, "Thank goodness!"

Here we are then, a little over a year later, concerning ourselves about second-level problems. For example, in this issue of Audio we present a rather comprehensive article on how to align and service multiplex equipment (see page 18). At the same time there is an increasing amount of conversation and literature concerning the need for an outdoor antenna to help solve one of the problems inherent in the new broadcasting technique: the effective range of FM-stereo transmission is not as great as mono transmission.

As vexing as problems of adequate service and signal level may be, they are not truly first-order problems. Clearly we have progressed beyond the "how do we do it?" stage and are in the "how do we improve it?" stage.

Perhaps one of the clearest indications of the technical sufficiency of present multiplex receiving equipment is that some 95 FM stations are, or shortly will be, broadcasting in stereo. Considering the relatively small number of "good music" stations, this number most likely represents a large percentage of the stations which could use stereo transmission to good advantage. Obviously these stations must believe that stereo broadcasts would be well received (in a variety of ways) or they wouldn't invest money in the special equipment required.

As we reflect about the exciting year just past, several thoughts and conclusions come to mind:

1. The audiofan enjoys stereo.
2. The audiofan will support new techniques and ideas if they are presented to him clearly.
3. High-fidelity manufacturers can act quickly to solve technical problems, and then quickly produce equipment based on the solution.
4. AM radio has been eliminated as a source for good music listening.

INSTRUCTION BOOKS

Several months ago we presented a few thoughts concerning the desirability of improved instruction books for kits. At that time we made clear our feeling that these books should encompass instruction as well as construction. But that isn't all we said; it was our feeling that the instruction should be integrated with the construction and that the terminology be understood by a wide range of constructors.

Recently we had the opportunity of previewing an instruction book which is the closest yet to our concept of the ideal; the book accompanying the new Award line kits by Harman-Kardon.

Of course we must make one fact clear: we have absolutely no knowledge about the kit itself (yet) since all that we have seen to date is the instruction manual.

Perhaps it would also be worthwhile to point out one obvious fact: an excellent instruction manual with a fair kit is not equal in value to an excellent kit with a poor instruction manual. The instruction manual makes a difference only when selecting between two kits of equal quality.

In any case, we believe that a step in the right direction should be recognized. Bravo H-K.

AUDIO CLUBS AGAIN

Last month, in our offer to aid in the formation of audio clubs we neglected to mention that there are several strong clubs already in existence. We were reminded that these existing clubs could be of great aid to beginning groups about the technicalities of organization. We were also reminded that these existing clubs might like to participate in our offer of aid.

Of course our offer includes existing groups. Just write and let us know how.
The Pickering Model U38/AT is a cartridge designed especially for the new generation of automatic turntables. A true STANTON Stereo Fluxvalve, it combines excellent hum shielding with high output for unequalled signal-to-noise ratio.

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

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

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

CHANNEL SEPARATION: 35 db

OUTPUT: 10 mv each channel

TRACKING FORCE: 2 to 5 grams

IMPEDANCE: 47,000 to 100,000 ohms

SHIELDING: Complete mu-metal

"FOR THOSE WHO CAN HEAR THE DIFFERENCE"

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

The hermetically sealed STANTON Stereo Fluxvalve is warranted for a lifetime and is covered under the following patents: U.S. Patent No. 2,917,590; Great Britain No. 763,372; Commonwealth of Canada No. 609,673; Japan No. 261,263; and other patents are pending throughout the world.

AUDIO • JUNE, 1962
How to Align Multiplex Adapters

H. HEINZ

Simple but lengthy step-by-step procedure for aligning multiplex adapters is given. With practice and understanding of the principles involved, a much abbreviated method can be used that still allows complete and accurate alignment of adapters. An instrument for performing these procedures is described.

Three basically different adjustments have to be performed during the alignment of multiplex adapters:

1. Adjustment of filters or traps that suppress interference from the background music channel (SCA) with the stereo reception.
2. Alignment of the 38-kc reinserted carrier for proper synchronization with the 19-kc pilot tone in the composite stereo signal.
3. Adjustment of stereo separation controls, if any, for maximum stereo separation.

Since the characteristics of tuners have a pronounced effect on stereo separation, this last adjustment should be made through the tuner with which the stereo adapter is to be used, wherever possible. When the tuner is not available, at least the output voltage from the detector circuit for a specified percentage of modulation should be known, so that the final adjustment can be made with the proper input voltage level.

The following test equipment is required: multiplex signal generator, audio signal generator, audio VTVM, oscilloscope with low-capacitance probe.

Step 1. If there are provisions for adjusting the SCA subchannel filter in the adapter, then this adjustment should always be done first, since the setting of this filter normally affects the operation of the adapter.

Two different types of filters are most widely used, the low-pass or band-pass types, depending on the circuitry of the adapter. The frequency characteristics of these filters are shown in Fig. 1. Both types of filters are adjusted for maximum attenuation at a given frequency. The procedure is as follows:

a. The audio generator is connected to the input of the adapter and the audio VTVM to the output of the filter. Adjust for minimum output at frequency specified by the manufacturer of the stereo adapter. (Use minimum input voltage, consistent with good indication on meter to avoid overloading the adapter amplifier circuits.)

b. Adjust for minimum output at frequency specified by the manufacturer of the stereo adapter. (Use minimum input voltage, consistent with good indication on meter to avoid overloading the adapter amplifier circuits.)

The frequency of maximum attenuation is most often 67 kc, the carrier frequency of the SCA subchannel. However, since the SCA information is distributed over the range of frequencies from 55 to 75 kc, many other logical choices for this frequency are possible depending upon the characteristics of the particular filter and the type of interference to be expected from the stereo detection system. (Fisher specifies 80 kc as the frequency of maximum attenuation for their low-pass filter.)

Step 2. Every adapter has provisions for generating a 38-kc signal synchronized in frequency and phase with the 19-kc pilot tone in the stereo signal. Toward this end, the pilot is filtered out from the composite stereo signal, then amplified and transformed into a 38-kc signal. This latter step can be achieved by a variety of methods involving either frequency-doubling circuits or synchronized oscillators and frequency doublers. Regardless of the method used, there are 19- and 38-kc tuned circuits employed that have to be adjusted properly. Some adapters have stereo indicators or stereo-mono switching circuits that should also be tested at this stage, since they work usually in conjunction with the presence of the pilot that distinguishes stereo broadcasts from mono broadcasts.

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* Project Engineer, Fisher Radio Corp., L. I. C., N. Y.
A voltage-variable and accurate 19-ke signal is required for these adjustments. This signal is connected to the input of the adapter. It is best to use an oscilloscope to monitor stability of synchronization and peak tuning of the tuned circuits. The test setup is shown in Fig. 2.

b. Connect the probe of the oscilloscope to the synchronized 38-ke signal in the adapter and connect the horizontal amplifier of the oscilloscope to the 19-ke input signal.

c. Observe the resultant patterns (one of those illustrated in Fig. 3 may be observed). The pattern indicates the amount of phase shift between the two signals.

d. For the 19-ke circuit adjustments, switch the oscilloscope to internal sweep and connect the low-capacitance input probe to the 19-ke circuits. The 19-ke input voltage to the adapter should be at a level that is to be expected from the tuner (e.g., if a tuner is specified to give 1-volt rms output voltage for a ±75-ke deviation signal, then the 19-ke voltage should be 10 percent of this voltage, or 100 mv).

e. The probe is then connected to the 38-ke circuits and the oscilloscope is switched to internal sweep input. The 38-ke circuits are now aligned for maximum amplitude and steady pattern as shown in Fig. 3.

f. The phase relationship is important, but it is not practical to try at this point for proper phasing of the synchronization since the correct pattern depends on the oscilloscope and also differs from adapter to adapter. However, whatever the pattern looks like it should not change appreciably when the 19-ke input voltage is varied from 0.5 to 1.5 times the expected pilot-carrier voltage. It will be seen that in most stereo adapters the phase of the synchronization is somewhat dependent upon the 19-ke input voltage, which is the reason why the final separation adjustments should be made with the correct input voltage to the adapter. The operation of the stereo indicator, if there is one, can be observed while varying the 19-ke input voltage for the synchronization test.

**Step 3.** Establish stereo separation in adapters in a function of proper 38-ke phasing and correct matrixing. It is also a function of the harmonics, amplitude, and phase distortions introduced by the adapter and tuner. The amplitude and phase distortion of the tuner can be partially compensated for by stereo separation controls. A proven alignment procedure for this step is as follows:

a. Connect the signal generator to the input of adapter and adjust the signal for a 1000 cps, left only, composite output signal of proper level.

b. Connect VTVM and oscilloscope to left output of adapter. Adjust 19-ke circuits and/or 38-ke circuits for maximum output indication on VTVM. This insures proper phasing. Care should be taken when adjusting synchronized oscillators at this stage to stay well within the range of synchronization. (The oscilloscope will show spikes superimposed on the 1000-eps output signal if the oscillator falls out of synchronization.)

c. Connect VTVM to right output and adjust stereo separation control to minimum indication. The difference between the readings obtained under b. and c. is the stereo separation.

d. Check stereo separation over the audio frequency range by varying the modulating frequencies from 50 to 15,000 cps.

e. Repeat b. and c. for right-only signals. Adjust balance controls. If possible, modulate left and right channels of the signal generator simultaneously with different tones and check left and right output for clean separation. If the tuner is available, or for tuners with integrated adapters this adjustment should always be made through the tuner by feeding the same type of stereo signal in the frequency-modulated form to the antenna terminals.

Depending on the available equipment and on personal preference many other ways of adjusting adapters can of course be devised, and it is not claimed that the adjustment procedure given is the "ne plus ultra." However, it is a proven method, that subjects the adapter to a very thorough test.

**The Shortcut Method**

For service and repair work a much faster method is feasible. In this procedure the signal generator is set to just one type of output signal, preferably employing different modulation frequencies of equal amplitude on each channel, say 60 eps right and 1000 eps left, and all synchronization and separation adjustments are made with this signal connected to the adapter input. The RCA filters, however, have to be adjusted first as explained previously.

For the following procedure it will be assumed, for the sake of clarity, that a 1000-cps left and 60-cps right tone is used for the stereo signal:

a. Connect oscilloscope to 19-ke circuits and tune for maximum indication on oscilloscope.

b. Connect oscilloscope to right output and adjust 38-ke circuits and/or 19-ke circuits for maximum 60-eps output on left channel. (With synchronized oscillators always check to make sure that the oscillator is set to the center of the synchronization range. This can be seen easily from the spikes appearing on the signal when the oscillator falls out of synchronization at either end of the range.)

c. Adjust separation control for the best stereo separation (minimum 1000-eps signal on 60-eps signal). Repeat b. and c. for best results.

d. Connect oscilloscope to left channel and check for clean 1000-eps tone on left channel.

This shortcut method requires some practice and it does not produce figures on separation, but it is adequate for service work and, of course, it saves time.

**A MULTIPLEX GENERATOR**

The Fisher Model 300 is a multiplexer generator suitable for research and design in the laboratory as well as service and alignment in the field. It is self-contained, requires a minimum of additional test equipment, and is compact and easily portable.

As shown in Fig. 4, the 19-ke crystal-controlled oscillator is used to generate the necessary "pilot carrier" and serves

![Fig. 2. Test setup for synchronization alignment.](image-url)

**Fig. 2.** Test setup for synchronization alignment.

![Fig. 3.](image-url)

**Fig. 3.** Lissajous patterns for observing synchronization of 38-ke signal (vertical) with 19-ke signal (horizontal).
as the basic timing mechanism for the signal generator. This oscillator is accurate in frequency to within 2 cps of 18-kc and is virtually free of drift. The 35-kc modulation frequency of the system is derived from this 19-kc signal by means of a frequency doubler. The 35-kc signal is then fed to the modulation unit as shown.

The audio generator provides either a 1000- or 5000-eps (sinusoidal) signal. In addition, a 60-eps signal (derived from the power line) is also made available for test purposes. This selection of test frequencies has been proven to be most useful in alignment, troubleshooting, and quick evaluation of multiplex adapters. In addition, it eliminates the expense and added complication of an external audio generator for modulation. The 1000- and 5000-eps signals are available at an output jack on the rear of the unit for external synchronization of an oscilloscope.

The left and right modulation signals then pass through individual level controls to the input amplifiers. These amplifiers can be switched from a flat frequency response to a standard 75-eps pre-emphasis response. This provides a quick test of the proper de-emphasis response in tuners and adapters without calculation. Moreover, this pre-emphasis permits playing of stereo program material through the built-in FM generator. The entire FM-stereo system (tuner and adapter) can thus be subjected to a listening test.

The audio signals from the input amplifiers are fed to the "multiplication unit" where they are combined with the 19-kc pilot carrier and, if desired, with an additional SCA signal, to form the total composite multiplex signal. Through a cathode-follower output, a low-pass filter, and the main output-voltage control, the signals then proceed to the "composite signal" output jack.

As shown, the composite output signal is fed to a built-in audio generator. The FM carrier frequency is factory adjusted to 100 mc but can easily be changed at the rear of the signal generator should it interfere with a local FM station. The FM generator not only permits the aforementioned listening tests of the FM-stereo system, but also is a valuable tool during design and alignment procedures. Without it, it is not possible to take into account any detrimental effects a tuner may have on the multiplex signal (which can be quite pronounced). A multiplex adapter aligned with a "near-perfect" multiplex signal will in many cases be partially out of alignment when viewed through the particular tuner to which it is connected.

The output meter, connected directly to the multiplex output jack, is used to indicate the output voltage, the modulation percentage of the FM generator, and the amplitude of the 19-kc pilot carrier. Separate scales are provided for each indication calibrated in rms values and ± kc of deviation. For the "rms" value of the complex composite signal it is understood that a one-volt indication on the meter means a 2.8-volt peak-to-peak amplitude. This type of indication is only possible with a true peak-to-peak meter if the reading is to be independent of the inputs used.

The meter can also be used for a quick check of the 19-kc carrier amplitude regardless of the type of modulation used. A pushbutton located underneath the meter short-circuits the modulation and automatically changes the meter sensitivity so that the pilot-carrier amplitude can be read directly on the pilot-carrier scale. Adjustment of the pilot-carrier amplitude can then be made from the front panel. In the 19-kc position of the Function Selector, the meter sensitivity is also automatically changed so that the amplitude of the 19-kc voltage can easily be read on the meter.

Special attention was given in the design of the unit to provide a simple method for monitoring and adjusting the phase of the pilot carrier relative to the composite output voltage. Normally this is quite a cumbersome procedure requiring a high-quality wideband oscilloscope and special filters as well as experienced personal judgment. The Model 300 uses a nulling method of phase adjustment that works well even with an inexpensive oscilloscope and allows discrimination between left and right input signals. To monitor the pilot-carrier phase, connect the signal generator to an oscilloscope and press the phase-calibrate pushbutton (under the meter). Adjustments can then be made from the front panel.

The power supply is of conventional design, providing a regulated +15-volt dc to the voltage-sensitive sections of the multiplex signal generator. It can be connected to either a 117-volt 60-eps line or a 220-volt 50-eps line.

The Modulation Unit

The following method is used to generate the stereo multiplex signal. If a switch connected between the left and right modulation inputs, as shown in (A) of Fig. 5, were to sample between the left and right signals at a rate of 38 kc, then the resultant signal would look like the one shown in (B) of Fig. 5. For one half-cycle of 38 kc, the output signal follows the left input signal, then the switch flips over to the right input. Since there is no right signal the output voltage will be zero for the next half-cycle of the 38-kc driving signal. Then the switch flips back to the left input and the output voltage again follows the left signal, and so on.

It is of interest to note that we have derived the signal by simply connecting a 38-kc switch between the left and right inputs—no complicated suppressed-carrier modulator, no matrixing, no filters, no phase shift, and no carrier suppression to worry about. To make an FCC-acceptable stereo signal out of the signal shown in Fig. 5, it is only necessary to pass it through a low-pass filter.

![Fig. 4(B) Block diagram.](image)

![Fig. 5. A 38-kc switch and the resultant signal.](image)
As shown in Fig. 6, the left and right signals are alternatively shorted to ground by switches $s_1$ and $s_2$, at a switching rate of 38 kc. (Two switches to ground instead of one switch in series are used for purely practical reasons.)

The individual chopped signals are passed through buffer stages and then combined in a resistive adding network. The pilot carrier (in correct phase and amplitude) and the SCA channels are added to the same networks. At point X, the total composite signal still contains all the harmonics that were generated in the switching process. As already explained, a low-pass filter between the output amplifier and the output jack will remove all these undesired frequencies.

The actual switches used in the circuit are Cowan-type diode switches, as shown in Fig. 7.

The diodes in this circuit are connected in such a manner that they are forward biased and conduct during one half-cycle of the 38-kc driving signal and are reverse biased and open during the other half-cycle. During their conduction period they present a low-impedance path to ground (approx. 300 ohms), while the resistance to ground during the open time interval is in the order of several megohms. Thus, they form an effective switch with the added advantage of suppressing the switching voltage at the audio take-off point because of the balanced-bridge arrangement. Diffused silicon diodes are used due to their high stability over a wide range of temperatures and their high ratio of forward to backward resistance. Figure 8 shows actual photographs of the stereo multiplex signals at various stages of the signal generator.

**The Crystal Oscillator and the Frequency Doubler**

A 12AT7 double triode is used for the oscillator circuit. This tube provides ample gain for sustained oscillation even when the 19-kc crystal changes as it ages. A capacitive trimmer allows fine adjustment of the oscillator frequency. The output circuit of the oscillator is a double-tuned 19-kc transformer, the secondary of which is capacitively tapped to provide a low-distortion low-impedance source for the fixed 19-kc output voltage and the pilot carrier. Note that both 19-kc voltages are taken from the same point, which is important for the phase-adjustment procedure. The plate circuit of the frequency-doubler pentode is tuned to 38 kc. It drives the diode switches in the modulator as explained earlier.

**Phase Adjustment**

The particular phase relationship of the pilot carrier to the stereo signal, as prescribed by the FCC standards, evades a nulling method of adjusting the phase relations, and makes it difficult to discriminate between left and right stereo signals. Had the FCC decided on a phase relationship of 45 deg., leading or lagging, then it would have been comparatively easy to adjust the phase and to discriminate between left and right signals. Any number of unambiguous procedures would then be available.

Making use of this fact, the Model 300 signal generator provides a 19-kc voltage on the front panel that is 45 deg. out of phase with the pilot carrier in the composite signal. Since it is desirable to have a fixed 19-kc voltage available for the alignment of adapters.

(Continued on page 55)
Professional Tape Reversing Mechanism

NORTH C. HAM

Playing a tape in the reverse direction involves more than just changing directions; the difference in torque between the take-up and supply-reel motors must be compensated for.

OBSOLESCENCE OF ELECTRONIC EQUIPMENT is always a vexing problem. A particular case in point is my acquisition of a Berlant Concertone approximately five years ago; a 20/20 TWR custom recorder adapted for 2-track stereo record-playback. The vexing decision was how best to "appreciate" the investment so that it could accommodate my backlog of favorite 2-track recorded tapes and also adapt to the presently available 4-track tapes.

The eventual decision made, considering the many possible combinations, was to modify the original tape deck to provide the following features:

1. Retain the original 2-track stereo record and playback features at speeds of 71/2 and 15 ips.
2. Retain the use of 7 and 10 1/2-in. reels.
3. Accommodate the new 4-track prerecorded tapes.
4. Include an automatic tape direction reverse for full continuous playback-rewind without jeopardizing wow and flutter.
5. Include a form of d.c. dynamic braking for reel stopping.

The first two mentioned features were easily accomplished by retaining the original mechanical structure and head placement composed of two ½-track erase heads, one 2-track record head, and one 2-track playback head. This total of four heads in a linear array is the original Concertone design.

The third and fourth features were accomplished by using two 4-track playback type heads displaced vertically and at right angles to the tape travel, and separated from each other on each side of the capstan drive-motor assembly. The 4-track heads are automatically switched dependent upon the tape direction. Tape head No. 1 matches track 1 and 3 for the forward direction and head No. 2 matches track 2 and 4 for the reverse or rewind mode. The pickup coils of head No. 2 are actually inverted relative to the matching coils on head No. 1 since the tape reels are not flipped for part two. This is necessary to maintain the proper left and right microphone placement between the part one and part two tape programs. Automatic reversing is accomplished by a light-beam sensing circuit together with a latching relay used as a memory device.

Fig. 1. Top view of tape deck with head covers removed.

Fig. 2. Mechanical arrangement and electrical analogue for forward direction.
The scheme is basically an inertial and non-pressure method and will operate reliably regardless of the reel size.

The last feature was obtained by switching 30 v. d.c. through the reel motor fields during the stopping period. A time-delay relay removes this current after a definite braking time. The original felt pressure-braking pads are retained and are useful as a backup and in maintaining a taut tape to reduce spillage during editing.

The result of these changes and additions is a tape recorder-playback mechanism with the following specifications:

<table>
<thead>
<tr>
<th>Feature</th>
<th>1/2-Track</th>
<th>2-Track</th>
<th>4-Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Playback</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>(Forward)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Reverse)</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape Speed</td>
<td>7 1/2 ips</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 ips</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Reel Sizes</td>
<td>up to 20%</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Wow and Flutter:</td>
<td>Less than</td>
<td>.15% rms</td>
<td>.15% rms</td>
</tr>
<tr>
<td>forward</td>
<td>.15% rms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse</td>
<td>.15% rms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Dynamic electrical braking plus mechanical brake.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Automatic shutdown after tape completion or breakage.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Selection of either 2-track or 4-track playback.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Fast reel spooling, forward and rewind.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Automatic reverse mode indication and disable.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Automatic forward play reset.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An important feature of the mechanical design, concerning head placement, was of great value in achieving the reversing feature. The Concertone TWR tape transport configuration utilizes the arrangement shown in Fig. 1. A supply reel pays off the tape which passes over a combination alignment guide, spring loaded compliance arm, and tape stabilizer inertial roller, then passes over the head assemblies. Then the tape is pulled by passing between a capstan with a constant tangential velocity and a rubber pressure roller. Following the capstan, the tape is again fed over another tape guide, compliance arm, and roller prior to being wound upon the take-up reel. Both the supply and take-up reel motors are energized during operation, but rotate in opposite directions, with the take-up motor having greater torque than the supply motor.

The simplified mechanical arrangement and the electrical analogue are shown in Fig. 2. The two inertial stabilizers located at both sides of the head assemblies, and the capstan flywheel, form a filter system which reduces the amount of flutter induced into the tape by the mechanical system. Because of the multiple-head arrangement used on this particular mechanism, the total tape friction is the sum of all the head and pressure-pad bearing frictions upon the tape. The total friction was reduced by replacing the original pressure pads with Teflon material risers interspersed between the heads. The risers, being above the head gap surface, provide adequate tape wrap. Also, the low coefficient of friction of Teflon results in reduced tape friction. This reduced friction allows the mechanical filter to have a sharper cutoff and greater attenuation near the filter cutoff frequency.

The resultant combination thus effectively filters out the flutter components of the 60 cps and its harmonics. The expression for the resonant frequency near cutoff is:

\[
f_r = \frac{1}{2\pi\sqrt{IC'}}
\]

where \( I \) = total inertia elements, \( C' \) = equivalent compliance.

This frequency is generally very low and approaches \( f_4 \) cps. The effective flutter-generator source is the difference in torque produced by the take-up and supply motors. The take-up motor has the greater torque because of the shunting impedance around the supply motor (see schematic, Fig. 6). Since the take-up motor is located at the right, during forward tape travel, the resultant is that the effective flutter current (d.c. component) in the electrical analogue, flows away from the higher potential towards the supply motor or against the steady d.c. current (constant tape travel). (See Fig. 2.) The heads, during this tape direction, are located as the head frictions \( R_1, R_2, R_3, \) and so forth. It is apparent that the flutter current at this point is low due to the two series filter components, \( I_2C_2 \) and \( I_3C_3 \), located between this point and the flutter driving generator.

In the case of the reverse tape direction, see Fig. 3, the reverse exists in that the motor at the left is now the take-up motor and its greater torque designates it as the driving flutter generator. Hence,
to reduce the flutter current, the ideal place for locating the reverse playback head would be at the point $R_2$ to benefit from the series components, $I_{C_2}$ and $I_{C_1}$. This fact was proven quite dramatically when the head was placed at this location (as against the initially tried location near $R_1$) - the reduction in flutter was considerable!

One major change to the original circuit concerns the modification of the capstan motor. The motor was disassembled and an extra connection made to the starting windings of the capacitor induction motor so that the polarity of this field may be reversed relative to the starting capacitor. This results in six separate cables emanating from the motor frame.

The remaining circuitry can be subdivided into the following main sections:

1. The memory device, latch relay $K_p$ which remembers whether the mode is forward or reverse play.
2. The reading circuit for reversing the tape direction composed of the photocell, lamp, and relay amplifier.
3. The reverse transient surge-current circuit for momentarily increasing the torque of the reverse mode take-up motor composed of thermal relay $K_7$ and 100-ohm resistor, $R_p$.
4. The power supply for the transistor circuit and d.c. braking circuit which is automatically removed by the time relay $K_5$.
5. The solenoids, $K_s$ and $K_r$, for selecting the proper playback head by the associated 6PDT rotary wafer switch.

Fig. 6. Schematic of control circuit.
When the line voltage is first applied, the latching relay, $K_L$, will be in the forward (tape direction) mode either initially or automatically by the action of relay $K_E$ which applies current to the proper latch coil through the crossed connection of the latch relay pole and coils. The latching relay, because of its mode is not de-energized, maintains the forward relays and solenoids in the normal forward direction mode. When the tape drive control lever is placed into the NUX position, normal forward mode operation results. This mode is also automatically achieved whenever the lever is returned to the STOP position; hence, the forward direction is reset by simply stopping the tape mechanism regardless of the particular direction of play at that time.

The sensing device for reversing is mounted at the left end of the tape pressure mounting rack so that, as the tape travels from left to right in the forward direction, the last program selection will be properly completed before reversing. (See Fig. 1.) Various methods can be used which trigger the sensing device by allowing the lamp to impinge upon the photocell mounted on the opposite side of the normally opaque tape—methods such as a small punched-out hole, or a clear portion of tape (either spliced in or removed oxide).

Switch $S_r$ is used to energize the transistor relay, $K_r$, thus permitting manual tape direction reversal at any time desired for the purpose of either program selection or the application of the reversing trigger spot.

An additional switch, $S_f$, allows the reversing light and transistor circuitry to be switched off whenever the reverse mode is not desired, such as during 2-track playback and recording. The lamp provides an automatic indication of this mode by allowing the light to pass through a colored plastic bezel.

After the tape has finished its last selection in the forward direction, and the (photocell) sensing circuit has been triggered, the sequence of operation is as follows: 1) The transistor relay, $K_r$, closes which immediately places the latching relay, $K_L$, into the "Reverse" memory position; 2) Simultaneously the reverse solenoid, $K_x$, receives an impulse that rotates the head selection switch to connect the proper pickup head to the preamplifier; and 3) The capstan motor is reversed and a current surge, for 4 seconds, is applied to the supply-reel motor which now becomes the take-up motor. The impulse-operated solenoid and latching relay scheme was used to eliminate the need for continuous energizing current. This accounts for the 48-v. a.c. being applied to the 24-v. solenoids and the 68-ohm dropping resistors, $R_x$ and $R_y$, for the 24-v. latching relays.

Fig. 7. Bottom view of the deck with chassis cover removed.

After the final selection has been completed, and the tape completely rewound, tape tension no longer causes the cutoff switch, $S_u$, to remain closed; and hence, the reel motors are automatically de-energized and the tape motion stops. Placing the control lever into the STOP position permits the completed tape reel to be changed and automatically resets the tape mechanism for the forward playback of the new tape reel.

The STOP mode, either actuated by the control lever or the tape spooling control lever, automatically removes the 115-v. a.c. potential from the reel motors by switch, $S_u$, and simultaneously applies 25-v. a.c. to these motors by the energizing of relay $K_r$. 115-v. a.c. also is removed from the normally energized relay, $K_L$, and, after a 3-second delay, capacitor $C$, discharges below the relay threshold removing the d.c. from the reel motors. The time constant comprised of $C$, and $R_f$, determines the delay time. The series resistor, $R_f$, determines the magnitude of the braking current and is selected as a compromise for fast braking of small reels, without causing tape stretch, and braking of the 10½-in. reels without causing loops.

The supply voltage for the transistor driver circuitry is regulated to 20 v. d.c. by employing a 20-v. zener diode and dropping resistor $R_{z2}$ to limit the diode current. The $Q_x$ base resistor, $R_{z1}$, is adjusted for holding the relay open under ambient light conditions and proper relay closing dependent upon the lamp intensity. The diode, $D_{SS}$, across relay $K_S$, is a surge-current protector for $Q_x$.

The SPDT switching of the 48-v. a.c. potential by relay $K'$ insures proper mode operation and eliminates oscillation in the relay loop.

The various playback heads are connected to wafer switches for 2-track, 4-track, and 4-track forward-reverse selection. The original preamplifier head was a triple coaxial arrangement to reduce circulating hum loop currents. (See Fig. 4.) This scheme was retained for reducing hum currents and, as a consequence, required a SPDT wafer-type switch. Figure 5 illustrates the over-all switching scheme for selecting between either 2-track or 4-track playback and the automatic switching for the 4-track forward-reverse modes (spring detent on wafer switch removed). The switches are enclosed within shielded boxes to reduce capacitance coupling of hum currents to the high-impedance cables.

Mechanically, the various relays, transformer, power supply, solenoids, and so forth were mounted on sheet-metal plates dispersed around the tape deck structure. (See Fig. 1.) The upper left plate comprises the time-delay relay circuitry $K_x$ and associated rectifier and capacitor-resistor time constant. The (Continued on page 57)

Fig. 8. Detail near capstan motor.
Power Supply with Protection

GEORGE FLETCHER COOPER

Design of a power supply capable of handling the current required by a high-powered transistor output stage—with built-in protection against thermal runaway.

When I wrote the article on a transistor protector which appeared in the December, 1961, issue of AUDIO, I concluded with a promise to describe the design of a big supply unit. The Editor failed to delete this and the promise became a threat to my peace of mind: possibly the Editor really wanted an article about a power unit. (It's did! isn't.)

Some little time ago I was faced by the very simple problem that transistors capable of carrying 15 amps were available and that 25-amp transistors were on their way: they were available, too, if one had that sort of money but at the prices then ruling they were strictly for applications using taxpayer's money. In order to use transistors of this size you need to have a supply of something rather more than 25 amps. For various reasons it was decided to standardize on a 12-volt supply which is about as high as one can go without moving up into a new price class: it corresponds to the practical limit of a 40-volt transistor used in a push-pull circuit with limiting conditions and some switching spikes.

I thus came to the conclusion that a power unit capable of giving about 14 volts at 30 amps was what was needed. The basic problem in a device of this kind is filtering. The load resistance can be down to roughly half an ohm and a check of the inductance and capacitance needed soon shows that you cannot get a practical answer by this method; both inductance and capacitance are out of this world and are strictly for the physicists. There are several ways of attacking the problem: they can be classified as shunt regulators, series regulators, and amplifier techniques. In all three we would start off with a moderately filtered supply having about one volt of ripple. Long, long ago this method was used for keying telegraph transmitters and called absorber keying. Using a tube, it is part of the filtering of one fairly recent communications receiver. The only trouble is that a shunt regulator needs a source impedance to work against, something which will prevent variations due to the current drawn by the regulator. Unfortunately this is certain to give poor regulation if we alter our useful load. Shunt regulators are of special value for use inside a piece of equipment where the current demand is fixed. We do not want a big power unit which we cannot use for small loads.

The amplifier type of filtering system makes use of a transformer with its secondary connected in series with the output. The primary of the transformer is connected to the output of a transistor amplifier which takes the ripple at the power unit output, amplifies it and feeds it back in series with the load but 180° out of phase. If we have, say, 1 volt of ripple before the transformer, and the voltage gain of the amplifier is 100 times, we shall just balance the ripple when we have 10 mv ripple at the output (this sum amounts to dropping the unit term in (1αβ)). The trouble here is that the transformer secondary must carry 30 amps and we cannot afford much phase shift at 100 or 120 c/s so that the transformer turns out to be a pretty bulky unit.

The series regulator is an amplifier unit, too, but we do not think of it in this way, at least not all the time. The great advantage of the series regulator is that it can be directly coupled all the way through. Thus it can stabilize the output voltage against the ripple, and it can stabilize against slow changes of input voltage, and also against changes due to changes of load. This looks ideal but there are some drawbacks which we must examine.

The basic idea of the series regulators can be seen from Fig. 1. The series transistor has its base fed by an amplifier with its input connected across the load. Suppose that for any reason the point A tends to go more negative. The current driven into the base by the amplifier will be reduced and the emitter voltage will tend to go positive and thus hold A constant. We can redraw the circuit in the form shown in Fig. 2 which shows the system as an amplifier with a grounded-collector output stage and full negative feedback. Without the preamplifier the output impedance of the grounded collector stage would be 1/Agm and with an amplifier giving a voltage gain A the output impedance is 1/Agm. A typical value for m is 10A/v (a round figure on the low side for the sort of transistor we use) and we might make A = 100 times, so that the source impedance could be 1/1000 ohm. At the collector the impedance might be 10,000 ohms if the slope of the collector characteristic corresponds to an rc value of 100 ohms. The ripple voltage of 1 volt at the collector will then produce only 0.1 mA ripple current through the transistor and we should use a transformer with a 1/5-ohm load. On the other hand the change of output voltage from no load to full load should be only 0.2 per cent.

The major problem is that the full 30 amps must flow through the series-regulator transistor. In the circuit I shall describe, the current is actually carried by three transistors in parallel so that they must take 10 amps each, a safe current for a 15-amp transistor. We can probably get a heat sink to give us...
a thermal resistance of 1-deg. C/W and the transistor may be the same. Let us say we will stop work if the ambient temperature reaches 40 deg. C (104 deg. F) and that the limiting junction temperature is 90 deg. C. We can then have 25 watts dissipation in each transistor and so we must limit the voltage across the transistor to 2.5 volts at 10 amps. This is just not good enough. We note that the 1-deg. C/W was a limit figure for the transistor and that 0.7 deg. C/W is a typical figure: we find that if we use a small blower we can get the heat sink down to 0.3 deg. C/W. These two terms will let us use 5 volts across the transistors.

How many volts do we need? We must always leave a minimum of 1 volt, because the transistor itself requires that to keep above the diode line. We have allowed for 1 volt peak-to-peak of ripple and so we are left with about 3 volts for regulation and control. Input supply variations will take up another volt, leaving only 2 volts for control. In my part of the world we think 30 deg. C is pretty hot but if I worked in a warmer climate I think I should use four control transistors and keep an eye on the temperature. With four transistors we should have 3 volts left for control, just enough to carry us from 11 volts to 14 volts which is the range we may expect from a battery in service.

The first step is to produce d.c. at about 15 volts. We need to provide some filtering of this and the rectifier must be a full-wave system. There seems to be little to choose between a bridge rectifier and a push-pull system: one is slightly cheaper than the other but with the price changes which take place so frequently in the semiconductor world the prices leap-frog. With a push-pull rectifier the transformer must deliver about 21 volts rms across each half of the secondary, while with a bridge, of course, you only have a single 21-volt winding. I do not propose to give details of this transformer because a 30 amp secondary wound with copper strip ¼-in. x ¼-in. is not something which can be treated as a home workshop job.

We are, of course, using a choke input filter. At lower current levels it is fashionable to build chokeless systems but the calculations we have carried out show that we shall then have trouble with transistor dissipation and I do not think that for general applications it is worth-while using the same ten transistors in parallel that would be required. The initial charging current would be rather high for most rectifiers, too. The minimum inductance is 0.5 mh and to have a good margin we designed for 1 mh. A point here is that the inductor might just as well be the same physical size as the transformer. The inductor air gap is adjusted to give maximum inductance when 30 amps is flowing, an adjustment easily made by running the rectifier and inductance-capacitance system as a simple power unit and setting the gap for minimum ripple. The ripple factor will be 0.83/LE102; with L=3 mh we get a ripple of 8 per cent with 10,000 μf and about 3 per cent with 30,000 μf. A 3-per cent ripple on a 20-volt supply is 1.7 volts peak-to-peak, or rather more than we allowed above but in fact we get a little more than 1 mh and there is some help to be got from the regulation: maybe we should find space for another 10,000 μf. At lower currents all is well, because the inductance rises to something above 50 mh.

So far we have a supply giving -18 volts at 30 amps. We need a couple of auxiliary supplies. One of these must be able to supply about half an amp at -20 volts while the other is a +6 volt supply providing only milliamperes. This second supply can be picked off the main transformer winding with a half-wave rectifier feeding a resistance-capacitance filter and a 6-volt zener diode: an additional secondary is provided for the -20 volt supply and in the circuit shown it shares the main inductor. This supply could do with a little more filtering. However, having got this far we might take Fig. 3 as the circuit of the basic power unit. It is rather heavily loaded with paper capacitors round the rectifiers to protect against power-line spikes.

The circuit of the amplifier is shown in Fig. 4. A fraction of the input is obtained by means of the 8-volt zener diode, Zn, and the potentiometer which acts as the voltage setting control. The zener diode gives an increase of about 3 times in sensitivity. This input is, of course, the voltage appearing across the

---

Fig. 3. The basic supply unit. The grounded shield and the diode capacitors, all 0.5 μf, are for protection of the rectifier against supply surges.

Fig. 4. The control amplifier including the two response-control RC networks.
final load and a pair of terminals is provided so that the input connection can be taken out to the actual load if the leads are at all long or links can be used if we want to keep the supply unit terminals at the regulated voltage.

The input signal is applied to one base of a long-tail transistor pair, $Q_1$ and $Q_2$. The other base, that of $Q_2$, is fed from a fraction of the constant voltage across the 6.8-volt zener diode $Z_v$. The long-tail pair is a differential amplifier and provides, at the collector of $Q_1$, an amplified voltage in phase with the input and proportional to the difference between the two base settings. At the design center of -12.5 volts, the transistors should each take 3 ma. In the preliminary setting up of the system, the two potentiometers are adjusted to give this condition, which corresponds to a little over -2 volts at each base. These two transistors are small general purpose transistors with a nominal gain of 40 and cannot be called on to withstand more than 20 volts or to pass more than 10 ma every manufacturer produces a small transistor of this kind. Transistor $Q_1$ is coupled directly to $Q_2$. A 100-ohm emitter resistance provides local negative feedback to stabilize the behavior of this transistor and with the collector load of 1000 ohms the stage voltage gain is just 10. Since the collector of $Q_1$ will be about -5 volts we return the bottom end of the emitter resistance of $Q_1$ to the zener diode, $Z_v$, which gives us a constant potential. $Q_1$ can pass up to about 15 ma and is thus rather larger than $Q_2$ and $Q_2$, although there is no reason why one should not use this larger type throughout: with some manufacturers it is possible to make a small saving here by using two types.

From the collector of $Q_1$ we go into a cascade of emitter followers, a triple compound system which finishes up in three or four power transistors. In this way we are enabled to control the final current of up to 30 amps with the few available milliamps at the collector of $Q_2$. Two features of interest are the diodes at the bases of $Q_3$ and $Q_4$, which are put in to provide a path for the collector leakage current when the bases are driven towards cut-off, and the use of resistances of 0.1 ohms in each of the final power transistor emitters to improve the current sharing. These resistors must be fairly closely matched although their value is not so critical: as they can dissipate 10 watts each they must be made of resistance alloy strip. It will not come as a surprise to readers of this journal to learn that when the feedback loop is closed we are likely to get instability at high frequencies. Two RC step networks were used to give a response running down fairly gently from a few hundred cycles and these gave the necessary shaping to provide stability. The dominating terms in the response are probably the cutoff characteristics of the power transistors and the driver stage. The trouble is that to operate the amplifier under proper test conditions one requires another power unit of the same kind. Transistor $Q_1$ is forced into cut-off. The potential $Q_1$ will also rise at a bi-stable switch. When $Q_1$ is forced into a high state we can catch it at 15 amps we shall probably save the equipment. One way of doing this is to use what is called a crowbar circuit in which a silicon controlled rectifier is placed across the supply before the control transistors, and is switched on if the current rises too high. This puts a short-circuit on the supply unit and blows the fuse. My own feeling about this is that although it might be used for industrial equipment it would soon be disconnected by the average experimenter. We need something a little less drastic. We can get the result we want by cutting off the regulator transistors $Q_{3,4}$. We must have some way in which this can be done firmly and quickly.

The first problem is to measure the current. For this we make use of the voltage drop across the emitter resistors of the regulator transistors. At 30 amps total current we shall have a drop of 1 volt each emitter resistance and we use this to drive a current into the emitter of transistor $Q_{11}$, an n-p-n transistor. (See Fig. 5.) This is a 2N35 or some other similar small n-p-n unit and as we have a low impedance at the emitter it acts as an adder to give an emitter current of 1 ma for a load current of 30 amps. We can work in terms of a grounded-base current gain of unity and we can then see that the collector current of $Q_{11}$ will also rise at the rate of 1 ma/30 amps. The potential at the cathode of $D_{11}$ will be +0.6 volts if no current is flowing in $Q_{11}$ and will go negative from +0.6 volts by the IR drop in $R_{11}$ and $P_{11}$.

The pair of transistors $Q_{12}$, $Q_{13}$ form a bi-stable switch. When $Q_{12}$ is conducting, the drop in the collector resistance brings the base feed to $Q_{13}$ down to a very small value, while $Q_{13}$ is forced into bottoming by the regenerative action.

(Continued on page 59)
New 380 FM Multiplex Tuner — Incorporates the latest advances in multiplex circuitry. Sensitivity 2.5 μv. 3 FM IF stages. Precision tuning meter. Silver-plated front end. Sharp filtering circuits permit flawless stereo tape recording. Stereo separation can match exacting FCC transmission specifications. $199.95, East of Rockies.

New 333 AM/FM Multiplex Tuner — Combines the features and performance of the 380 FM Multiplex tuner with a famous Scott Wide-Range AM tuner all on one compact chassis. You can receive Monophonic AM or FM, AM/FM stereo or new FM Multiplex Stereo. FM sensitivity 2.2 μv. Two AM bandwidth positions. Loopstick antenna for AM.

LT-110 Wide-Band FM Multiplex Tuner Kit — Build your own fabulous Scott Tuner. The LT-110 includes the same superb multiplex circuitry as the 380. Pre-wired multiplex section and front end. Full color instruction book. You can build the LT-110 in less than 12 hours. Sensitivity 2.2 μv. $159.95, East of Rockies.
NEW FROM SCOTT

FINEST FM MULTIPLEX TUNER IN THE WORLD

WITH AMAZING ELECTRONIC BRAIN

THAT ACTUALLY THINKS FOR YOU!

This Wide-Band FM multiplex tuner is designed for the most critical stereo listener and for the most exacting applications imaginable. Its many features and stringent standards of performance make it the prudent choice for broadcast station monitoring. The famed advanced engineering group at H.H. Scott believes the sophisticated circuitry of the 4310 to represent the highest possible achievement in tuner engineering at this state of the art. This circuitry results in IHFM sensitivity of 1.9 microvolts. Scott’s revolutionary Time-Switching multiplex section gives you practically noise-free reception of even weakest stereo signals, with separation of 30 db or better... truly an outstanding design achievement.

This superb tuner incorporates an amazing new “electronic brain” which is invaluable for serious tape recordists and discriminating listeners. As you tune across the FM dial, the 4310 AUTOMATICALLY switches to multiplex when a stereo broadcast is reached. If serious interference occurs, however, the tuner will switch back instantly and automatically to the monophonic FM mode, which is less susceptible to background noise. You completely disable this feature if you so desire, or you can set it so that switching occurs at that level of interference which you consider objectionable. Using this automatic feature, you hear practically flawless reception, with the tuner instantly picking the optimum mode for existing signal conditions.

This feature is essential for the tape recordist who wishes his recordings of prized material to be undisturbed by sudden interference, as often happens on very weak signals. The exceptional design and advanced features of the new H. H. Scott 4310 have already established new standards of achievement in the FM Field.

IMPORTANT TECHNICAL INFORMATION: IHFM sensitivity 1.9 μV; Capture ratio 2.2 db; Signal to noise ratio 60 dB; Harmonic distortion 0.5%; Frequency response 30-15,000 cps ± 1db; Selectivity 50 db; 4 FM IF stages; Cascade RF stage; Size in accessory case 15½ W x 5¼ H x 13¼ D. Rack mounted model available for broadcast station use.

Write today for technical details on these new tuners:


Separate VU meter for each channel. You can actually measure stereo separation between channels with these accurate meters enabling you to tune and orient your antenna for maximum stereo separation. Separate controls allow adjustment for broadcasts having unequal channel levels. Precision step-type master attenuator.


Unique circuit features: Diversity facilities for monitor and rebroadcast installations; Special tape recording filters; Automatic Stereo Threshold; Heavily silver plated encode front end; Provision for 72 ohm or 300 ohm balanced or unbalanced antenna inputs; 600 ohm output available. Automatic switching from monophonic to multiplex.
There have been many new developments in tonearm design in the last year to cope with the ever-improving stereo cartridge. As cartridges requiring lower tracking forces have become available, the need for better tonearms has become evident. "Dynamic balance" and "anti-skating force" have become passwords in tonearm design. Integration of arms and cartridges has reduced the number of variables the designer has to contend with. And yet, "inner groove distortion" continues to be a part of the audiophiles' vocabulary. Before going into that, however, let us first look at the status of playback geometry.

Important improvements in cartridges have been made in two areas. First, whereas the compliance of early stereo cartridges rarely exceeded $3 \times 10^{-8}$ centimeters/dyne, cartridges with a compliance of $10 \times 10^{-8}$ and higher are not uncommon today. Just as important, the moving mass of the stylus assembly has been considerably reduced. Moving masses of less than 1 milligram are now available. Both of these improvements have resulted in smoother response, lower distortion, and reduced record wear due to decreased tracking forces. But decreased tracking forces have made the job of the tonearm—that of keeping the cartridge in the correct relationship to the groove without exerting external influences on it—more difficult.

The correct relationship between the cartridge and the groove is governed by the way stereo records are cut. In the cutting process a heated, chisel-like stylus travels across the record in a straight line toward the center. The record turns at a constant 33 1/3 rpm, forming a continuous groove spiraling in toward the center. For convenience, however, a single revolution is referred to as a groove—an outside groove being longer than one at the inside. The groove is modulated by both horizontal and vertical motions of the stylus. To play back a groove properly, the stylus of a cartridge must be perpendicular to the record surface, and the longitudinal axis of the cartridge must be parallel to the section of the groove being reproduced.

Finally, a tracking force perpendicular to the record must be kept constant so that the stylus neither loses contact with the groove, nor deforms it with excessive pressure.

The smaller diameter, and thus smaller surface area, of the stereo stylus requires that stylus force be reduced. Since the original LP stylus was 1 mil in diameter and the first commercial stereo stylus was 0.7 mil, the effect was that of doubling stylus forces. To keep record wear at a minimum, tracking forces about one-half those required with monophonic records were called for. Now the 0.5-mil stylus has caused a similar decrease in tracking force. Thus, whereas tracking forces of 5 to 8 grams were common before stereo and 2 grams was an absolute minimum, now 3 grams is considered a maximum for the safety of records and tracking forces lower than 1 gram are possible. Tracking forces in excess of 3 grams tend to erase high frequencies and distort transient peaks in the groove modulations.

To make possible lower tracking forces, tonearm designers have had to reexamine old problems, and evaluate previously unimportant forces which now tend to upset the correct relationship between the stylus and the groove. Initially, stereo tonearms were rewired monophonic tonearms. Next, small modifications to the old arms were made, and some new ideas tested. Now old designs have been rejected, and new ones are taking their place. New shapes, new adjustments, and new refinements characterize recent designs. The most noticeable advance has been concerned with the dynamic aspects of arm design—having to do with forces encountered as the tonearm moves across the record surface.

"Dynamic balance" helps to solve the old problem of turntable leveling, while also improving tracking under such adverse conditions as acoustic feedback or external vibrations and shock. Some of the first "dynamically balanced" tonearms were units in which the counterweight completely balanced out the weight of the cartridge, and then tracking force was applied by a spring which was unaffected by the position of the turntable with respect to the earth. This reduced the need for turntable leveling, and also reduced skipping and repeating due to external shocks. A variation of the "dynamically balanced" tonearm is the arm balanced in the lateral plane, but unbalanced in the vertical plane to produce the desired tracking force. This does away with the spring while still producing the balanced effect, and is accomplished through the use of pivots offset along the longitudinal axis of the arm. Since the arm is laterally balanced at only one tracking force, and with only one cartridge weight, however, the use of this method is essentially limited to integrated tonearms.

"Anti-skating force" is the name given to a compensation for two unrelated forces which tend to upset the correct relationship between the stylus and the groove. The first force is that of arm inertia as the tonearm moves across the record. This is a constant force, reducing the pressure on the outer groove walls and increasing the pressure on the inner groove walls. The second force is a re-

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sult of the fact that the stylus is generally overhung a small distance from the record center to reduce tracking error. As the arm moves toward the center, it tends to accelerate inward due to the changing angle between the groove axis and the longitudinal axis of the tonearm. Since a force to compensate for these two effects depends on arm mass, overhang distance, and tracking force, it also is essentially limited to use in integrated tonearms.

Even with integrated tonearms, "dynamically balanced," and compensated for arm inertia and stylus friction with "anti-skating force," "inner groove distortion" still exists. The reason for this distortion must lie, then, in the geometric conditions under which the tonearm operates. Further reason for this belief is provided by the observation that arms of increased length tend to minimize the distortion noticeably. A tonearm of infinite length would allow the stylus to travel in a straight line across the record and pick up groove modulations exactly as they were cut.

Tonearms of finite length, however, carry the stylus across the record on an arc governed by the length of the arm. Tracking error—the difference between the longitudinal axis of the cartridge and the groove axis—is a result of the difference between the paths of the cutter stylus and the playback stylus across the record. It is possible to determine mathematically what angle the longitudinal axis of the cartridge should be offset from that of the tonearm to give zero tracking error. Since the offset angle is generally a fixed value, the problem is to orient the stylus with respect to the record so as to hold to a minimum the difference between the chosen offset angle and the tracking angle at any given radius of the record. Since tracking error can be reduced by overhanging the stylus a small distance from the record center, given an arm of fixed length, the two variables are overhang distance and offset angle. Both variables are quite critical, especially overhang distance—a 1/16-in. change affects tracking angle by more than 1 degree for most tonearm lengths, and more for extremely short arms.

Compare the tracking error of arm "A" with that of arm "B" as shown in Fig. 1. Arm "A" is typical of recent stereo tonearms. It has a maximum error of only 2.1 deg., and has less than 1.5-deg. over most of the record. Arm "B," on the other hand, has a maximum error of 6.8 deg., and has more than 1.5-deg. error over most of the record. Assuming that tracking error causes the same amount of distortion at any radius of the record, arm "A" is obviously the better of the two. These figures on tracking error apply to a 12-in. LP record cut from a maximum radius of 5.75 in. to a minimum radius of 2.25 in., and played back with an arm which measures 9.0 in. from stylus to pivot—which is to say an average 12-in. arm. The tracking error curves are essentially repeated tracking angle curves for two values of overhang.

A graph of tracking angle for arm "A," Fig. 2, shows that it has an overhang of 3/8 in. and that the tracking angle curve is parabolic in shape with a maximum tracking angle of 25.2 deg. at 5.75 in., a minimum tracking angle of slightly over 21.4 deg. at between 3.25 in. and 3.5 in., and a second high angle of 23.1 deg. at 2.25 in. The chosen offset angle is 23.1 degrees which means that the section of the curve between 2.25 in. and 4.75 in., produces "negative" tracking error and the section of the curve between 4.75 in. and 5.75 in. produces "positive" error. A graph of tracking angle for arm "B," Fig. 3, shows that it has an overhang of 5/16 in. The curve is again parabolic, but has only one maximum value, which is 21.9 deg. Since the chosen offset angle is 15.1 deg., the maximum error is 6.8 deg. Here the error is always positive, and decreases at a constant rate approaching the inner grooves.

Both arm "A" and arm "B" have zero tracking error at the 2.25 in. radius of the record. On many records the inside groove is as far out as the 3.5-in. radius. Both arms, then, are designed to play the innermost groove encountered on a 12-in. LP. Both arms could have been designed with zero error at some radius other than 2.25 in., but it can easily be seen that this would seriously compromise reproduction of records which were recorded in as far as 2.25 in. while reducing over-all tracking error by only a small amount. The important question is which of the two arms represents the better choice of overhang distance.

Fig. 2. Tracking angle graph for arm "A" of Fig. 1. With offset angle of 23.1 deg., error is never more than 2 deg., and a minimum in the center grooves.

Fig. 3. Graph for arm "B" shows a maximum error of 6.8 deg when used with an offset angle of 15.1 deg.

Fig. 4. Comparison of 1000-cps groove at different diameters.
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EQUIPMENT

PROFILE

LEAK "SANDWICH"
LOUDSPEAKER

We first became aware of this new Leak product through reports in several British periodicals. Natural enough since Leak is a British firm. The nature of the reports and the known high quality of other Leak equipment made us rather impatient to hear for ourselves. Finally after having waited for some time, we finally got an opportunity to listen to a unit. We must report that the hearing of our British cousins is similar to ours—in this case, the new Leak speaker system is an excellent sounding unit, and should go extremely well in the modern American home with its scarcity of high-frequency absorbing materials. It is also very handsome in appearance as shown in Fig. 1.

Description

The Leak speaker system contains a 13-in. woofer and a 3-in. tweeter in a completely sealed enclosure. The walls of the enclosure, although only 5/8-in. thick are stiffened internally by a coating of thick bituminous material (see Fig. 2) which is supposed to give the effect of a 1-in. thick panel. The woofer is mounted from the front of the baffle and the tweeter is attached to the removable front grill, as shown in Fig. 2. The front panel is fastened to the main body by means of four spring-clip fasteners.

The tweeter is completely isolated from the rest of the enclosure to avoid harmful interactions and is a special unit with a molded-paper cone, a plasticized cloth surround, and a 1-in. voice coil. We can see from Fig. 3 that It has an unusually heavy magnet system.

The woofer utilizes an unusually rugged and massive aluminum frame-casting and a heavy magnet structure. The really unusual feature of the woofer is the construction of the cone. It consists of an expanded polystyrene molded diaphragm 3/8-in. thick with a hemispherical section at the apex. Both front and rear surfaces are covered with thin aluminum foil to give an extremely high stiffness-to-mass ratio. It also gives rise to the title "sandwich." The surround is made from a treated cloth material which is designed to isolate the movement of the cone from the rear. About 1/2-in. cone travel is achieved. Free-air resonance of the unbaflled woofer is 30 cps.

A half-section crossover network is used which utilizes air-core inductors and electrolytic capacitors, and has a crossover frequency of 1200 cps. As shown in Fig. 2 the network components are mounted on a heavy wood block which in turn is mounted to the rear of the enclosure. In essence then, the network and the wooden block make up a wedge between the rear of the speaker magnet structure and the rear wall of the enclosure. This makes for a rigid rear wall whose resonance may be controlled somewhat.

The Rigid Cone

The "sandwich" cone is made of 3/8-in. thick foamed plastic with thin aluminum skins applied to both the front and rear surfaces. The reason for this unusual structure is to increase the stiffness of the cone without increasing its mass. Ideally a cone would act like a piston. That is, when force (signal) is applied in a particular direction, the entire cone goes in that direction at the same time and with the same amount of force at all points. Unfortunately, with paper-coned speakers, especially the larger ones, it is possible for the cone to be traveling in opposite directions at various points and at the same time. This is due to the inertia of the cone, its ability to flex, and the fact that soft paper will absorb a certain amount of energy. Thus, the outward movement at the portion of the cone near the voice coil may be "cancelled" by a backward movement further out. Obviously then if the cone is made more rigid, and lighter at the same time, the tendency of the cone to "break-up" would be materially reduced. That is what this foam sandwich on aluminum is supposed to do; the effective improvement in stiffness over a paper cone of the same mass is estimated at 300 times. The point of

Fig. 1. Leak "Sandwich" loudspeaker system.

Fig. 2. Cutaway view of Leak speaker system.
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design that many audiofans know so well.

This cartridge was designed to fill a very special slot created by the introduction of high-quality automatic record-playing equipment in recent years; units such as the Dual 1006 Custom, the Garrard Model A, the Miracond Model 10-H, to mention just a few, really require far better cartridges than their predecessors. To put it another way, they will take full advantage of a better cartridge.

The major area of difference is in compliance. In the past, in order to meet the rigors of automatic operation, a cartridge had to be quite rugged and non-compliant. This was necessitated because the minimum tracking force acceptable for good performance (by the record-playing equipment) was 6 grams.

With the power equipment it is possible to have tracking forces in the 2-5 gram range. Naturally this permits the use of a more compliant cartridge. In essence then, the cartridge has to be intermediate in compliance between the stiff older cartridges (tracking forces in the 10-15 gram range) and the very compliant cartridges intended for non-automatic equipment (2 grams to less than 1 gram).

Performance

The results of our tests show that the Pickering Model U38/AT meets its design goal and is worthy of taking its place in the other Fluent-solvers. In listening tests it revealed an unusually smooth response with a tight solid bottom end and a top end which drops slightly (its response is plus or minus 2 db from 20 cps to 15,000 cps). This is the range of our measurements. Channel separation at 100 cps was 34 db and the output per channel was 10 mv (2 mv/equs of recorded level).

One of the outstanding features of this cartridge, if it is true to its line, is unusual if it is another way, black hole. In our estimation this cartridge is just what is needed by the automatic record player.

Circuit Details

The Knight-kit vtm consists primarily of a three-stage amplifier (with 30 db of feedback) which feeds a bridge rectifier circuit, in turn relays the indicator, which is a d.c. meter calibrated in a.c. volts and in db. The output of the rectifier is also applied to a sensing or trigger amplifier which outputs a small amplifier to turn the range switch to the next step higher in sensitivity whenever the voltage goes above about 20 per cent of full scale, and to the next step lower in sensitivity whenever the voltage goes above about 97 per cent of full-scale deflection. An indicator light shows just which step the switch is on. Presiding the three-stage amplifier is a cathode follower to provide a high input impedance (10 megohms on all ranges). The ranges extend from 3 millivolts to 300 volts full scale in 10-db steps.

Another feature is the provision of an amplifier output for feeding other equipment with a signal of 0.15 volts at full-scale deflection of the meter on any range. The voltmeter section is flat ± 0 db from 20 cps to 500 kHz or ± 2 db from 20 cps to 2.0 kc.

Construction

The instrument is constructed in two separate parts, as shown in Fig. 5, with the amplifier and metering section at the front and the power and sensing sections at the back, ensuring sufficient ventilation. Direct current is used on the heaters of the cathode-follower input stage and on the first two stages of the amplifier, and the plate voltages are regulated with a two-stage amplifier controlling two triodes as series-type regulators. Plate supply voltage is less than 3 volts over a 20 per cent change in line voltage.

Construction is simplified by the use of two printed-circuit boards—one for the amplifier, one for the meter and rectifier circuits, and one for the trigger or sensing circuits.

One calibrating control is provided for the amplifier, and once set should not need to be changed unless a tube burns out. We have been using this instrument for over a year and since we consider it our standard we have had it checked three times against laboratory standards with no

(Continued on page 56)
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Audio • June, 1962
Here is a heartfelt, though 'premeditated
Inc. is one of exciting performances of the oldest church
ances. The Deller Consort, instrumental ensemble.
ter of the "old art" of music at the turn of
lusts, at first astonishingly "wrong" until the sense of these con-
bodements begins to tell on the ear.
Both works (to the Gothic spirit) both
are part and parcel of the Gothic cathedral itself, that combination of immensity and infinite detail of moving strength and grumb-
ingutility (as in the gargoyles, or the dreadfully realistic fragment of hell-fire).

Through recordings so convincingly musical as this, we can begin to see that music was,
Indeed, as alive in the Gothic time as was
iment even superceding the demands of na-

ting ear, though convinced of the sin-

eographer, Ward.} The Deller Consort.

This is a splendid and important recording,

Vanguard BGV 5045 stereo

This is a splendid and important recording,

Vanguard VDS 2108 stereo

A noble and worthwhile effort, this, to

Vanguard VDS 2108 stereo

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Vanguard BG 615 mono

At first thought it might seem unreal to pick an outstanding Austrian harpsichordist to play this very special French music. But harpsichordists are a tight clan with rigorous standards of style and scholarship among themselves, the requirements of their instru-

Vanguard BG 615 mono

Two lovely cantatas done up in full-blown Austrian style with top Austrian talent in the lead parts and the nobly weekly Akademie
Choir in the choral portions—you can't go wrong here, though, as in all cantata performances, the chorus often has less than its ideal realization of the now-difficult music. Somehow, the Academy's multiple vibrato does not produce the line-of-sight and earnest sincerity behind the singers. But it must be said that, in this sort of music) makes the sense clear, the somewhat heavy Austrian approach seems appropriate. One is grateful for the absence of the driving dynamics heard in U. S. performances.


Vanguard BSG 5032 stereo

Vanguard's recordings generally are on quite a high level that I hate to resort to criticism, but here it seems necessary—not even everyone can be perfect all the time.

Outwardly, this is a fine project and worthy. The Parcell Suites are poignantly superb music, unmatched in the entire musical literature of the period. The chamber orchestra is of the right size for their production, the acoustics are lovely and the recording is superb.

Only the performance is wrong—very wrong. What I deplore is the rather old, pre-authoritative, pre-authority of playing, dating back to the turn of the century and apparently handed down to Mr. Mahler and his relations. The music-tight blinders—as if nothing had should be played with a pounding, marcato beat, minus phrasing, banging along like so many heavy freight cars pounding the rails. Ugly ritardos, ending with a mannered "ugh," a certain sameness and dullness. Most of the tunes are pretty sappy, though well dressed up. Somehow, the Akademie's multiple vibrato does not often seem to annoy; the fine musicianship and earnest sincerity behind the singers had better stay away. They'll boil, or simmer, or merely be an

Italian Music of the Renaissance. Choir and Solists of the Polistonica Ambrosiana, Men; Giuseppe Biallo.

Vanguard BG 623 mono

It is perhaps the worst blooper of a dirty trick in the whole history of early music that Vox brought out years ago—and recently released.

It is not mere that these Italians, like so many of their colleagues in the business sing the old music in super-Caruso style, like a drunk driver from "The Prodigies," out of a very prevalent opera house! They have a right to their own concept of "Renaissance" style, even if it is indistinguishable from bad-taste. What really costs is that the recording is done in one take, as well as with a slurring, vibrato-ridden lack of ensemble.

Still, this is the plain musical accuracy is another. The first short unaccompanied item on this record, taken in a couple minutes. The succeeding numbers continue to sag disasterously, as though the singers never stood so much as turned the chord in proper tune. Few of their harmonies are.

Since my own choral group of American amateurs once did this same sort of music for a half hour or so with pitch deviations, I'm in a position to shoot with horror. I do so not.

True Religion and Other Blues, Ballads and Folk Songs. Erik Darling.

Vanguard VRS 3239 mono

Vanguard's unique folk music program has been enormously successful, and on both sides of a very narrow line, that which divides "authentic" folk music from "popular." Indeed, the unusual variations in this sort of music to walk this line straight down the middle—though some critics will push the company to its limits and thus will be wide open to the eternally wrong here, though as in all cantata portions, operations in the same language, ever so pure. All these varieties are here represented, in the somewhat raucously expressive Hebrew of Damarit, guitarist, harpist, zomma—a heterogenous collection, are her accompaniment.

ODITIES

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by Debussey, for example—will make an absorbing study for those who still own the old Columbia recordings. They are the same, yet not the same. The difference helps us to understand the virtue and the limitations of the Welte-Mignon system as perfected back in 1903 and put to work taking down the great composers and pianists in person, up until the outbreak of World War I.

The Welte-Mignon was a super-recording piano that took note of virtually all the elements of a performance, and could play them back again with an accuracy that is still remarkable after almost sixty years of conventional recording. The recording machine dipped carbon rods variably into a pool of conventional recording. The recording machine was, theoretically at least, reproducible in with an artificial finger. Still does, and now (Ordinary reproducing pianos played them all the same). Thus the whole range of "touch" was, theoretically at least, reproducible in playback. The playing machine rolled up to a piano keyboard and actually "played" it with artificial fingers. Still does, and now all we need do is to put our miles nearby to hear Debussey, Grieg, Saint-Saëns, Mahler, Ravel, playing once again.

Well, most people still say it sounds false. In a curious way it is false—but to pin down just how is a tough problem. My own feeling is that much has to do with the pedaling, the most difficult subtlety to reproduce, since the pianist's foot often "half-pedals" admittance by ear to blur the sounds to an exact degree of expressiveness.

I seem to be right; the Debussy played in these two different recordings over ten years apart, though from the same master recording, is clearly not the same in respect to clarity of definition. The Telephone pedaling is less blurred, for a much more natural and musical sound than in the earlier Columbia playing. Evidently there are adjustments that can be made, within the musical judgment of the present-day operator.

The new recordings are cleaner, steadier in pitch and on much improved surfaces—all purely LP factors. The piano is clearly a different one and it is better recorded in the new series, though stereo recording would have added a really up-to-date touch.

Waitzes from Old Vienna. (Josef, Johann Strauss; Joseph Lanner.) Alexander Schneider, with string quartet.

Columbia MS 6316 stereo (hono: ML5716)

This is a repeat performance, if I remember well, a batch of old waitzes done up in an unusual fashion by a small solo ensemble of strings. In place of the usual large orchestra, Alexander Schneider is the impresario for the occasion and his strings plays all the tunes.

In fact, I can't share how the other distinguished musicians managed to avoid utter boredom—Felix Gallimir, Walter Trampler, Paul Arthur, and Louis Prima on the double bass (no collas). For hundreds of measures all any of them get to do is the last two thirds of the waltz once-pah-pah. Just pah-pah, pah-pah, ad infinitum, over and over again, while the brilliant Mr. Schneider plays the waltzes-proper.

Except for the two Johann Strauss waitzes ending each side, the music is familiar, the Lanner pieces sounding rather Schubertian, though he was called the "Mozarit of dance music" according to Columbia's notes.

The Magic of the Bells.

Mercury S 90189 stereo

I grabbed this one eagerly, knowing Mercury's penchant for extraordinary sound effects—I expected a battery of ringing-of-the-changes, etc., maybe Russian, maybe out of an Indian temple or something. I didn't look closely enough at the label. All you get here is a list of rather sanctimonious hymns, hounded out at ultra-close-range—you can see the whites of the bell-ringer's eyeballs—the on the Spellman Rockefeller Memorial Carillon of the Riverside Church in New York.

The flute and the stereo are terrible. But the normal sound of these hymns is received from afar, down below, and as installed, this closeup is a tonal distortion equivalent to standing inside a brace of organ pipes during a full-organ perforation. Maybe the thing to do is to jack up your loudspeaker onto the roof and play hymns for the neighborhood. The more distant they are, the better.

(Come to think of it, there's a steady commercial demand for bell records, to be played through large loudspeakers installed in little poky church attics. Mercury may well clean up on this one.)

BIG COMPOSERS

Stravinsky Conducts Stravinsky—The Firebird (orig. version, complete ballet).

Columbia MS 6238 stereo (mono: ML 5728)

Stravinsky Conducts Stravinsky—Petrouchka (1947 revision, complete ballet).

Columbia MS 6332 stereo (hono: ML 5732)

Igor Stravinsky Conducts, 1961. (Movement for Piano and Orch., Double Canon; Epiphaphrum for Flute, Clarinet and Harp; Octet for Winds; L'Histoire du Soldat.)

Columbia MS 6272 stereo (mono: ML 5472)

(All above with Columbia Symphony Orch.)

Columbia isanny—has been for a long time. Back in the Thirties the company issued The with Stravinsky conducting his own works—still I have some, including the first "Histoire du Soldat". It's very outmoded by RCA, Columbia bought its time and grabbed the composer back, though presumably RCA did not have to pay Stravinsky the top, and less. But just look at the price.

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Setting the Stage for Grand Opera

Reported by: R. KATZ*

Recreating the stage settings and effects enhances performances for this opera lover

The “Teatro Internacional de Horwitz,” presents performances of the world’s greatest operas by the world’s most renowned artists. It represents the culmination of a lifetime devotion to opera by Robert Horwitz, who created an “opera house” in the basement of his Philadelphia home.

The only “live” performer in the Teatro is Robert Horwitz who narrates the libretto. All of the 10,000 performances in the repertoire are recorded. The unique feature is that stage settings, lighting, and effects are meticulously reproduced to simulate the realism of the original performances (see Fig. 1).

Included in the repertoire are nearly all of the recordings of Enrico Caruso, Jussi Björling, John McCormack, Nellie Melba, Alina Gluck, Titta Ruffo, Maria Nemet—indeed, many of the great opera recordings made in the past 50 years. Some are so rare that no more than twelve cuts are in existence.

The audience arrives to receive a warm welcome by the Horwitz family. They are escorted through a paneled door bearing a plaque inscribed “Teatro Internacional de Horwitz.” Descending a staircase along a velvet rope, they enter the Teatro itself. They are presented with specially prepared and printed programmes, and shown to red plush theatre seats, beneath walls studded with photos of opera “greats.”

As the audience settles back, the orchestra is heard tuning up. Suddenly there is silence. The lights dim, and recorded applause announces that the conductor has stepped up to the podium, and the performance is about to begin. Robert Horwitz steps into a spotlight in front of the stage. He welcomes the audience, gives a brief history of the evening’s opera, and outlines the action of the entire plot. The spotlight fades. There is a rustle of anticipation in the audience.

At the first bars of music swell through the Teatro, the gold-braided, red-velvet curtain rises on a miniature stage. The stage lights come up on a precise replica of the stage of New York’s Metropolitan Opera House.

The scenery is changed during intermissions. All of the light cues, set cues, curtain cues, and so on are listed with detailed accuracy on a stage-manager’s cue-sheet. Every performance is timed so that lighting and other effects occur at the proper moment. Horwitz, with an assistant, operates these effects from a control board.

The range of effects is unusually varied: the set can be made to appear wreathed in flames; fog blows across the barren heath where three witches await Macbeth; snow falls on Mimì and Rodolfo’s Paris in “La Bohème”; rain, thunder, lightning, night and day enhance the realism.

The scenery is built to scale in meticulous detail. Photographs of sets in the world’s major opera houses are used as models. Nothing is omitted. If antique furniture is called for, careful replicas of each piece are painstakingly carved, painted, and upholstered by hand. A magnificent chandelier has been assembled.

The stage was completed in 1951. Since preparation time is so great, the number of performances is limited to four each season. Also, an operatic “surprise party” is given annually. The “surprise party” is a potpourri of the rarest selections from the Teatro library. This season’s “surprise party” included a performance of Act II, Scene 2 of “Manon Lescaut” by Puccini, for which the chandelier was made.

The Teatro’s 30 seats are always reserved for the audience. There are long waiting lists of persons who wish to attend performances. Requests arrive as much as nine months in advance of a performance. Many offers of payment are received and politely refused, since the Teatro does not charge admission.

Horowitz’s equipment includes: two Electro-Voice Aristocrat corner enclosures each housing 12TRXB speakers, a pair of H.H. Scott 222C amplifiers, and the new Empire 950 Horn and cartridge. Naturally the performances are “stereo.”

Fig. 1. Closeup of the stage.

Fig. 2. Robert Horwitz (R) confers with the Teatro’s Musical Consultant, Bob Moyer (L), and Ben Cohen (center), who co-ordinates the theatrical fabrics. Note printed programme.

Fig. 3. Bob Horwitz introduces a selection for the operatic “Surprise Party.”

Fig. 4. Now the performance! To the left of the stage is a life-sized photo of Arturo Toscanini, who appears to be listening intently, and directing the opera in progress. Note the glass-enclosed turntable.
Sonny Rollins: The Bridge

RCA Victor LSP2527

Bridging the river of ink which started to flow when Sonny Rollins went into voluntary seclusion is a lengthy task, so there should be no regrets over leaving the printed page to become immersed in the waves of sound made of those skeptics who expressed doubt that bouquets are tossed to the jazz reporters for man's entry into the RCA Victor fold and kms sums up the whole story in the liner notes. Coltrane, Ornette Coleman, Eric Dolphy and the rest of the newer jazz abstractionists. As his efforts he helped found this school of improvisations, as soon as he worked out conclusive ly that his reasons for taking a lull aby. Ballads also are handled with a lighter touch than before, but the airier appeal is no less firm and compelling on Without A Song, Where Are You, and You Do Something To Me.

Even the quarter-hour is admirably fitted to bridge any of the various jazz streams, a watch continues for the right drummer, as the two New Faces of 1955, recording groups have no longer, it remains for Rollins to consolidate his forces, resound in earlier work, and in striving to attain stylistic perfection.

The big news about the quartet's first studio trip in the new mark Rollins sat as a player rather than any claim the group might make to being more "out" than the next one. Not that anyone can say originality and an adventurous spirit are lacking, as guitarist Jim Hall and bassist Bob Cranshaw turn up fresh ideas almost constantly. Nothing is done solely for shock effect, though, and everything fits into the over-all design.

Only Rollins knows how narrow a victory the bridge's classic symmetry won over the noise, outmoded range of Wall Street's skycrapers, but the title piece clearly indicates the decision won. Long, graceful choruses of 3:4, plus solos to help the imagination along, will enable even those listeners who were actually there to reach out and absorb the whole experience as hard to grasp as the same volume point, looking downstream at the Brooklyn Bridge. Few from being the most creative artists to succumb to the powerful atmosphere of a bridge. Repeated training from the record company includes the poet Hart Crane, who viewed the same panorama from Brooklyn Heights. Such structures never figured prominently as sources of jazz inspiration until now, but Rollins seems to have learned a lesson about form that will be useful and will sell at least one more bridge.

Sonny Rollins always held form in healthy respect is apparent in his earlier recordings, and other factors important to his latest stage of development should not be placed in secondary positions. Improved breath control was pursued through regular exercises all during the vacation period, resulting in accumulated dividends which pay off in this recording. Because of increased facility and greater control of his horn, complex ideas become lucid and are more easily accessible to the listener. Along with Miles Davis and other who have undergone similar experiences, Louis Armstrong's passion for physical fitness, and the popular image of absolute jazz musicians is no longer valid. The majority keep in better condition throughout the year as many baseball players do out of season.

Although Rollins does his thinking in the post-Parker idiom, he bridges the gap in total control of the blues. Not by much does he still fully35ed masters as Coleman Hawkins and Don Byas. Just because Parker's ideas and techniques were amaz ing enough to be given priority is no excuse for his followers to fail to prove that an unforced handling of unimpacted tones is better equipped than ever to get a message across, and does, without straining his voice in the nude cutret and strident sounds constantly being practiced today. Perhaps the most remarkable example yet of his immense tonal range is set forth on a song Billy Holiday recorded as The Child, in which phrases are driven home with riveting gun fire or cowed with the tenderness of a ballet. Rollins also are handled with a lighter touch than before, but the airier approach is no less firm and compelling on Without A Song, Where Are You, and You Do Something To Me.

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Oliver Nelson: Africa/American Sketches

Prestige Stereo 7235

Although the charge of futility is often levied against jazz fans, they are nowhere near as avid in pursuit of latest fashions as the record companies. A jazz label needs only to offer an album with Africa in the title to beat out the mounting these days, and so some of the hurried productions already on the shelves. This latest arrival is obviously designed to catch the trend, and not the one to do. Nelson has gone straight for the roots, his Afro-American Sketches is as pure as an apple.

If everyone who likes a touch of early jazz or New Orleans music would be named for a joint award of the Nobel Prize for Peace.

The recording session took place just midnight, after rehearsals but prior to the show, and everyone concerned enjoyed reliving out of sight of the probing cameras. The choruses are a little longer, spirits lighter, and the sound a whole lot hotter. The four-track stereo tape gives a good idea of what television sound should be like for 1957, but why wait? If or five minutes of unused time and end cuts, Nelson's version of Somebody's Rockin' Now, Chasin' boss, or another of the original recording dates before July 1954. I'll Remember April, How Deep Is The Ocean, and Basin Street Blues show up, and Ray Hall is credited with handling the deck.

Cannonball Adderley: In New York

Riverside Stereo RLP9404

Recent changes in Cannonball Adderley's personnel brought in two new saxes, swelling the ranks to sextet and adding a third tenor. Considering the band's last album under that title, there's little to be said. Always one to go direct to the source, the leader steps into the role of commentator by placing the leading saxes hand by hand. Of Joe Rawlin, a pianist born thirty years ago, a trumpeter born twenty years ago, and a contrabassist born twenty years ago. As the Conservatory at the age of seven. As
the jazz waltz did much to establish the group's popularity, requests for at least one such number must be answered during each set, and no new album would be complete without the inclusion of a freshly written original. Sawturl will undoubtedly be called upon to meet future requests due to his Austrian background, but the current attraction comes from the pen of Jimmy Heath. Titled after the constellation Gemini, the tune was written with the twin-stared solo efforts of the Adderley brothers in mind, and they combine to send it into the lucrative orbit enjoyed by such previous successes as This Here, and Dot Here. Sawturl prefers to show how thoroughly Americanized he has become, making an opening bid as composer with Scotch And Water, a plodding blues line which probably owes something to Dinah Washington. Since arriving in this country four years ago, Sawturl worked as the singer's accompanist after a stint with Maynard Ferguson, and he fits right in with the rhythm team of Sam Jones, bass, and drummer Louis Hayes.

The sixth man is Yusaf Lateef, whose sound on tenor sax in no way conceals his former status as a resident of Detroit. Only when doubling on flute or oboe does he unfold the exotic ideas which might originate with a native son of North Africa. While Lateef's new job calls for none of his really odd instruments such as an argol, earthboard, or inflated balloons for cooing, he manages to cover a good deal of uncharted territory with just ooze on a work of his own named Syn-anthe8ia. His main function is to provide the extra ensemble strength of a third horn, and the group sound shows an appreciable gain in depth to go with the global increase in breadth of style. When either Cannonball, on alto sax, or Nat, on trumpet, tries on too sharp a continental cut, the other slips in a homely reminder of their plain Florida upbringing. The leader acts as a benevolent host, introducing each number in this location recording at the Village Vanguard, and engineering honors go to Ray Fowler.

Kay Starr: I Cry By Night
Capitol Stereo 511681
Gerry Wiggins: Relax And Enjoy It
Contemporary Stereo 57595

The singer who refuses to heed her pianist's advice had better beware, as no lesser criticism can be gained from any source. Gerald Wiggins has worked as Kay Starr's accompanist for more than a decade, taking time out to assist other singers on records and to coach Marilyn Monroe for vocalist roles in films. They worry about their sound success or missing the top forty, he undoubtedly urges each of them to "relax and enjoy it." And like many of Miss Starr's regular fans, he quite possibly suggested a change of pace of the sort accomplished on her latest offering. Instead of the brassy style and careful arrangements used before large audiences in clubs, the singer works with a skilled jazz sextet and directs her sentiments at the select listeners grouped in any room living. The songs all deal with unrequited love or errant lovers, and Miss Starr calls on persuasive reserves to make believable such themes as More Than You Know, My Kinda Love, and I'm Alone Because I Love You. Manny Klein plays subdued, melodic tenor in the background, and Red Webster's tenor sax unfolds a lyric plaint on Lover Man. But Miss Starr's first concern seems to be pleasing the acclaim of her pianist, and the result is a highly remarkable album.

Wiggins transports his talents as accompanist over to trio dates, showing a knack for an unsuspected turn of phrase and never allowing the passages to become too florid. The group heard here gets together at odd intervals, when Renee Middle From Joe Comfort from playing bass on studio jobs, and drummer Jackie Mills vacation after touring with Harry James. Wiggins carries with him a vocalist's preference for tasteful ballads, and the unprecedented also turns up again in the choice of tunes. General laughter would be heard in any jazz club following a request for Ethelbert Nevin's Norostrum, but Wiggins indulges in this favorite of self-appraising American pianists without waiting to be asked. Nobody is likely to laugh either, as a swinging corrective quickly straightens out the popular impressions that the piece was meant to like

THE MAGNEFON BY

Somewhere Norse of the 60th parallel a hearty breed of men reign supreme. A good part of their fame was built upon their devotion to duty and their ability to tell the forces from the trees. America's Audio Dealers, another hardy breed, are continually searching far and wide to find the best boys on earth for their stereo high fidelity customers. Such is the case with the MAGNEFON stereo tape recorder manufactured by Luxor in Motala, Sweden. This is truly one of the finest values ever presented. Realistically designed to perform all of the important functions without unnecessary frills the Luxor-MAGNEFON is carefully crafted to stringent engineering standards. In many respects, the Luxor matches the performance of machines literally costing twice as much. It is available for $279.00 in every good Hi-Fi-Tepee in town.
along. Credit Titum as reigning influence, Wiggins keeps technical displays from obscuring the melody on The Lady Is A Tramp, and My Heart Blood Still. Blue Wisp, the lone original included, manages to cover territory from Mondy-Lue Lewis to Thelonious Monk. Roy Du Nanne's fine recording makes relaxing to enjoy the trio no trouble at all.

Sound Effects, Volume 3

Audio Fidelity Stereo DFS7011

A sound effects library can never be too large. Just because the catalog lists a certain item is no guarantee that the recorded effect will not also incorporate into a given dramatic sequence. As sound in its purest form rarely fits human situations, this tightly wound volume of selections from Audio Fidelity's library consists mainly of sounds heard against a natural or realistic background. The array of police car sirens with other traffic noises and the close-up click of telephone knobs, a battery of typewriter machine rats and rattles among all the other activities of a busy newspaper office. The usual of tortured metal scratches from an actual machine shop, and the various clock interludes include a visit to a chicken coop shop. The hiss of a welder's torch is present in the blast of an air hose and the heavy crunch of an electrolyte cylinder being rolled across a concrete floor. Rainfall comes accompanied by thunder, city traffic, or the quiet rustle of trees and underbrush placement, and the nature of the equipment used in recording and playback. It is easy to see why the work of a sound effects man never ends. If complete accuracy was the rule, just keeping track of all the

FRANZ JACKSON: Jazz, Jazz, Jazz

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vocalist. Pat Yankee comes to the fore and applies her special brand of vulgar charity to Big Butter And Egg Man, and Last Chance Road; but the unholy star of the show in this ellipse, and the sooner it returns the better.

Paul Eakins: Nickel Music

Audio Fidelity Stereo AFSD5960

Five cents may not go very far today, but the nickel harmonies on the cover of this album would either start a substantial bank account or buy a toy in Federal penitentiary for misfitting. A plain ordinary nickel, however, is still legal tender at Gay Nineties Village, a tourist attraction in St. Peter's, Missouri, and home of the world's largest collection of old-time automatic music machines. Paul Eakins, a retired mechanical engineer, hunted down and repaired the instruments as a hobby, then hit upon the idea of building a village to put a roof over his nuts. In the interests of authenticity, he can hardly increase the cost of an item whose very name sets a price-fixing policy not enjoyed by cigars, candy bars, newspapers and other products that once sold for a nickel. Of course, inflation attack the competing Juvenile Industry several years ago.

Elvis Presley by moaning, the sidelong slam midway between the older carousel and the omnipresent jukebox. While making small effort to provide for weekly hit songs, the manufacturers did try to keep abreast of current trends and often built in special effects not found in carousels. For example, the popular instrument of traveling minstrel shows is retumed by the Record Bank, which was patented in 1893. Equipped with piezo-acoustic plates of torsion, the bank plays four strings for a total of 44 notes. The Wurlitzer Francher, an ordinary tenor, baritone, violin and banjo pipe. The Eakins Special, assembled by the proprietor to suit the present market, consists of 63-note organ manual. The Memory Lane and the Red K. T. Specials both include microphones and attachments. All feature percussion of various sorts and sizes, and tempos are brisk and lively on such turn-of-the-century tunes as Hoop Dee Hoop Dee and the like, plays four strings for a total of 44 notes. The Wurlitzer Francher, an ordinary tenor, baritone, violin and banjo pipe. The Eakins Special, assembled by the proprietor to suit the present market, consists of 63-note organ manual. The Memory Lane and the Red K. T. Specials both include microphones and attachments. All feature percussion of various sorts and sizes, and tempos are brisk and lively on such turn-of-the-century tunes as Hoop Dee Hoop Dee and the like.

Jo Stafford: American Folk Songs

Capitol Stereo ST1653

Burl Ives: Songs Of The West

Decca Stereo DL74179

Store folk singing is now big business. quite a few top singers take an occasional one-off on the field, thereby setting an example that can be followed in reverse just as easily. Jo Stafford is no recent convert, having made foray in this direction before during frequent ventures outside her usual category. A singer who returns to be pigeonholed, she brings a bright and cheerful air to musical branches on which she happens to be propped at the moment. Her intentions seem to be entirely friendly this time, and real lady songsters need not become alarmed to the point of flying deeper into the woods. Instead, they had better listen and learn, as a new few tricks, which Miss Staffordritte the surrounding countryside with news of Barbara Allen, Old Maid of Shipwrecked, and Poor Man's Waltz. Paul Weston falls quite naturally into the role of admiring male in the ballad, conducting a choir of strings and woodwinds in the background. The I'llerl tunes are accented by the banjo plucking of Joe McPhee.

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THE ART OF SPLICE HUNTING

ROGERLY SPEAKING, there are two main categories of hobbies. The conventional type might embrace such things as collecting butterflies, records, and postage stamps; driving antique cars; assembling "hi-fi" rigs; re-enacting Civil War battles; and firing off rockets. Around these activities flow an endless stream of magazines, books, pamphlets, and newspaper articles. The conventional hobbyist organizes clubs, meets in conventions, arranges for shows and exhibitions, sometimes wears lapel buttons, and often spends large sums of money in pursuit of hobby-happiness, to the despair of his budget-minded spouse.

The unconventional hobbies generally involve far less expense. Take fault-finding. Now we all indulge in the everyday variety of fault-finding, thinking of it not as a hobby but as a reflex conditioned by our taste, background, and education. It evolves into a hobby only when it has become impersonal and has reached technical sophistication.

The movie fault-finder, for example, watches for "seams" and exposure differences in triple-screen Cinema presentations. He is ever on the alert for costume bloopers, a common occurrence in which the film editor has failed to notice a change in apparel from one take to the next in a supposedly continuous scene, or has allowed synchronisms to creep into a historical production.

Sight and sound synchronization is a favorite quarry of the cinematic fault-finder. Because the dialogue and effects of today's movies are sometimes recorded after the shooting, it is especially important for the actor's lips to correspond perfectly with the words he is uttering. Even when he himself has recorded his own part, poor lip-synchronization becomes a presence-destroyer, particularly in close-ups.

Acoustical mismatch is a frequent companion of faulty lip-synchronization. The insensitive film recorder overlooks the fact that a studio pickup may not relate to the outdoor scene for which it is recorded. A pair of actors standing in an open field must not be made to sound as if they were seated in a sound-proofed studio, leaving large gaps in a script.

The playground of the literary fault-finder offers even more attractions than that of his cinematic counterpart. In it, the hobbyist may buy the City Editions of The New York Times and The New York Herald Tribune to ferret out "typos" (typographical errors) which are bound to be caught and corrected in the double-proofed Late City Editions. He scans the menus of would-be fashionable restaurants for such classic bloopers as "Soup du Jour." And he reads the letters to the fold-out editors to revel in syntax-distortion and howling hyperbole.

At the dial of his FM radio, the musical fault-finder lies in wait for the gaffe announcer who stumbles through the names of composers and musical compositions and occasionally comes up with such gems as "... the opera, "Jewels of the Madison," by Emanuel Wolf-Ferrari," or "Pierre Monteux conducted the Paris Conservative Orchestra... ."

And into which category would you place the fault-finder who visits Washington Square Park on a Sunday afternoon to witness an exhibition of delightfully imperfect lasso-twirling by a Manhattan cowboy named Texas Weinsteins?

For sheer esoterica, however, nothing quite approaches splice hunting. This rarified hobby is practiced almost exclusively by musicians and tape editors, because one must be able to read an orchestral score and have had some experience at the tape deck.

The splice hunter seeks his prey in the grooves of recordings. He will not find it if the master tape from which the disc cut has been skillfully edited. Unlike people, splices are either good or bad; if good, they are inaudible and do not interrupt the natural flow of the music; if not, they draw attention in several ways.

Drop-out. The editor here has joined takes of different levels of intensity. This is a common splice fault and is easy to detect. We are in the midst of a forte passage which culminates in a series of powerful tutsi attacks. Suddenly the volume of sound dips sharply, for no musical reason. For an instant, we feel sonically weightless, just as if we were in an elevator which had taken a fast plunge.

Drop-out of a more elusive character can result from shifts in musical balance. This is especially difficult to spot when the "presence" of a solo instrument remains uniform and only an un-
derlying segment of the orchestra, say, the French horns, is reduced in level.

Pitch. Unless the 'A' is sounded at frequent intervals during a recording session, the overall intonation of even the finest ensembles will begin to dip. It is the responsibility of the recording director to see to it that the pitch is always "up there." At the slightest sign of sag, he should call for a tuning. Unless this is done, the danger is that the tape editor will be compelled to bring together takes and re-takes which are noticeably different in pitch. Of course, it goes without saying that intonation problems arise in the normal course of a performance, but these are "live," not spliced faults.

Rhythm. The pianist is executing a difficult run, flawless except for one sixteenth-note. Later, the editor removes the blemish and splices in a clean note from another take. In performing this bit of cosmetic surgery, however, he has cut out a fraction of an inch more than he has replaced, producing what might be termed the "time-out-joint effect."

Tempo. Back in the Thirties, Arturo Toscanini recorded Brahms' "Variations on a Theme by Haydn." Some twelve years later, he re-recorded the same work with the N.B.C. Symphony. The timings of both performances are only seconds apart! Few conductors possess such an uncanny sense of tempo discipline. Yet this quality is essential in the recording session, where a tempo variation can sometimes turn an otherwise perfect re-take into a worthless ribbon of tape. Capricious changes of pace are present in too large a part of the LP repertoire. The experienced splice hunter is able to separate natural tempo differences from those created with the editor's blade.

Acoustics. Weather plays an important role in the acoustical character of a recorded performance. On sharp, clear days, instruments sound brighter than on muggy, low-baronetar days. With this in mind, record producers attempt to complete a given work on the same day so as to avoid running over into radically different weather situations. Acoustical changes of this sort can be spotted by only the most proficient splice hunters.

Double-Note. The tape editor has grease-pencilled his splice point (a trumpet attack) and now makes his cut. He similarly marks and blades the re-take. He joins them together. But something is wrong: the trumpet seems to have played its first note twice. This is known as tape stutter, a phenomenon caused by the fact that the editor cut late on the outgoing take, and early on the incoming take, thus retaining part of the trumpet attack on Take A, and the same attack again on Take B.

The highest compliment the splice hunter can pay to a recording director is: "Terrific! I didn't hear a single splice!"

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The First Book of its Kind—No Other Like It!

SOUND in the THEATRE
by Harold Burris-Meyer and Vincent Mallory

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

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

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LONELH AMPTON: Soft Vibes

Columbia CO-424

In these tapes we find two great stars of the swing era acknowledging the changes that have overtaken the band business. Two tunes making up the vast bulk of these reels are items that would have appeared only once in a blue moon on the programs of the Basie and Hampton orchestras in former years. It is somewhat disheartening to find two record labels sharing the opinion that ballads are items that would have appeared only once in twenty-five songs in rapid succession. The new look in "bookshelf" speakers. Place a speaker on each end, amplifier and tuner on the adjustable shelf, and your components are transformed into a striking stereo cabinet which will highlight every interior and accent your fine components. Naturally, crafted from the finest of hardwoods in a choice of finishes. See your dealer or write for free brochure of the complete line.

Crosby tape makes up in quantity what it may lack in novelty. The latest production for Warner Bros., from Project Records, takes its nickname from the purchase of this tape probably not to dawdle when he takes on a collection of tunes. Each Side of this reel embraces twenty-five songs in rapid succession. The new look in "bookshelf" speakers. Place a speaker on each end, amplifier and tuner on the adjustable shelf, and your components are transformed into a striking stereo cabinet which will highlight every interior and accent your fine components. Naturally, crafted from the finest of hardwoods in a choice of finishes. See your dealer or write for free brochure of the complete line.

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NEW PRODUCTS

- Transistorized Integrated Stereo System. Designed as the "Astro," the new Altec-Lansing Model 708A is a completely transistorized FM tuner-amplifier system packaged on a single chassis and employs transistor circuits. The Astro contains mono AM and FM tuners, FM-multiplex stereo, dual automatic selector, stereo speaker outputs. Features include pushbutton selection of Channel 1 or 2, or both; separate volume controls for each channel; master volume control for playback; playback tone controls; built-in sound-in-sound recording facilities; two high-level line inputs for recording FM stereo; stereo line outputs for connection to high-quality mono amplifiers; and auxiliary speaker outputs. The Sony 464-CS comes equipped with two dynamic Sony F-7 microphones. The price is $259.90 complete. SuperScope, Inc., Sun Valley, Calif. F-3

- Tuner-Amplifier. H. H. Scott, Inc. announces a new high-performance combination featuring the "Sonic-Monitor." The Model 340 is a 60-watt FM tuner-amplifier and the first Scott product to feature this new device. When the FM listener wants to determine which stereo is on the air, he simply switches the Sonic-Monitor to "monitor" position and tunes across the dial. When he hears the monitor tone coming from his speaker, he knows that he is tuned to a station broadcasting in FM stereo. Then all he need do is switch the Sonic-Monitor to "Listen" position to hear programs in stereo. Other features of the Model 340 include a high-quality tuning meter, a sub-channel noise filter, and special filtering for stereo tape recording. Size, in its accessory case is 17%-in. wide, by 6%-in. high, by 13%-in. deep. Price, of the Rockies, is $375.34. H. H. Scott, Inc., Maynard, Mass. F-3

- Equipment Cabinets. Concentrating on designs for the compact speaker, Audio Originals has created a series of designs which will accommodate a variety of standard components in an over-all integrated design. The Boulevard model shown features convenient pull-out changer or turntable shelf, two adjustable component shelves, space for hundreds of records, and a tape deck too. It is 71/2-in. long, 17-in. high, and 14-in. deep. The speaker compartment is 25% x 14%. The Model 201 sells for $49.50 and is shipped knocked down. It weighs 80 pounds. Audio Originals, Indianapolis, Indiana. F-3

- Multiplex Adapter. Dynaco, Inc. has recently introduced a multiplex adapter, designed to complement the new Dynatuner, called the FMX-3 Multiplex Integrator. This unit fits all Dynatuners and is wholly contained in the chassis. It was designed for full utilization of the Dynatuner characteristics. Wholly automatic in operation, the FMX-3 provides identical mono signals in both channels or stereo signals separated by at least 20 db. When a stereo signal is received, its presence is indicated on the front panel—the word STEREO lights up. Utilizing a push-pull envelope-detection system, the FMX-3 requires neither muting nor balancing, and precise alignment is a matter of a few minutes time for the home constructor using the "Sterobeam" as an alignment indicator. The FMX-3 kit (a 5-hour project) costs just $33.35 and the complete multiplex tuner, factory assembled and tested, is available for $169.95. Dynaco, Inc., Philadelphia 4, Pa. F-3

- Stereo Preamplifier. Featuring a new type of "rocker control" the Mackintosh Model C-11 requires approximately 40 per cent fewer knobs than comparable conventional preamps. The "rocker controls" are employed for functions most often used and their instant response permits rapid adjustment when changing programs. The Model C-11 has a frequency response of plus or minus 0.5 db from 20 cps to 20,000 cps with distortion of less than 0.1 per cent at the full rated output over the entire frequency range. Additional features include three input selectors, auxiliary signal source, and tape monitor inputs have an impedance of 350,000 ohms and a sensitivity of 0.24 volts, accepting signals up to 19 volts (30 for tape monitor). The phone inputs will accept 2 mv at 47,000 ohms; the tape head input will accept 2 mv at 1 megohm; and the microphone input will accept 2.5 mv at 1 megohm. The masts output is 2.5 volts with rated input. The output is 0.25 volts with rated input. Controls include an 8-position input selector, a tri-position mode selector, bass and treble controls (for each channel), which have switch points, stereo balance control, and a master volume control. Finished of the Model C-11 is gold and charcoal. It may be installed in

audio • june, 1962
If you were not among the 10,123 kit-builders who received this first issue

...you're missing something

The first issue of the quarterly R·A·E Journal has now been received by more than 10,000 members of the R·A·E Society - the national organization devoted to the interests of radio, audio, and electronic kit-builders. From initial reports, the Journal is a resounding success. Comments from Society members say: "Bravo" - "Something we have really needed" - "It's a must for kit-builders" - "Filled with wonderful, original ideas."

The R·A·E Journal is available only to members of the Society. You can't buy a copy anywhere. However, more copies are being mailed out daily. You can have one, too. So read on.

WHY THE FIRST ISSUE OF THE JOURNAL SCORED A BULL'S EYE

Under the direction of Milton B. Sleeper, one of the radio-audio pioneers and a recognized authority on kit design, the R·A·E Journal is devoted exclusively to the interests of kit-builders (no record reviews or articles on music).

The new issue contains ten articles and departments on kit design, kit construction, system planning, Society activities, and related subjects. The Journal serves beginners as well as advanced enthusiasts with how-to-articles, reports, and comments written in a clear, concise manner, profusely illustrated with drawings and photographs handsomely printed on fine paper.

It is filled with original ideas, plans, and information on interesting things you can do with simple tools and a kitchen table for a workshop.

When the Journal gets into controversial subjects, no holds are barred. Parts of the "Notes and Comments" and "Members' Roundtable" might be labeled "Too Hot to Handle!" Altogether, you will find the R·A·E Society's Journal unique, stimulating, authoritative.

Most valuable of all are the articles on new kits - kits unlike any you have ever seen because they incorporate developments and practices borrowed from precision instruments and military equipment, but in practical form, suited to home construction.

THE FIRST R·A·E KITS

The first R·A·E kits will be available in August. The overall design, assembly and wiring methods, appearance of the finished instruments, and even the instructions and diagrams are totally unlike any now available. They are not instruments in kit form that were originally designed for factory production-line assembly. R·A·E kits are designed by kit-builders, specifically for kit-builders.

R·A·E SOCIETY MEMBERS SERVE ON THE ADVANCE-TEST PANELS

Before a new R·A·E kit is released, it will be pre-checked by Society members in this way: Ten prototypes will be given to 10 members, some of whom are beginners, some advanced enthusiasts and professionals. Each will assemble his kit and report on his experiences. In return, he will keep the finished kit, without charge. A new panel will be chosen for each new kit; no member may serve twice. Any Society member may apply to serve on an Advance-Test Panel. No purchase of equipment is necessary.

You are invited to join the R·A·E Society

Whether you are a beginner or an experienced kit-builder, you are invited to join the R·A·E Society. Details of the Society's activities are published in the Journal. Annual dues of $4.00 entitle you to all privileges of membership, to receive four issues of the quarterly Journal, and to quality for service on an Advance-Test Panel.

Use the coupon below or your own stationery. Read the UNCONDITIONAL GUARANTEE in the coupon.

To get the first issue of the Journal, rush your membership application today!
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...TRANSIENT RESPONSE—Unique low inertial single metal diaphragm system results in superior transient response and crystal clear definition at highest levels. Especially obvious when recording cymbals, trumpets or piano.

...FREQUENCY RESPONSE — AT LAST, a condenser microphone without high frequency peaks. Piano and voice are reproduced without shrillness.

...LACK OF HISTORION — Significantly lower distortion, never exceeding 0.3% at sound pressure levels to 115dB above 0.0002 microbar, impossible to overload condenser capsule.

...FRONT-TO-BACK RATIO — Highest wideband rejection over the important midrange; at least 26dB. Since directional patterns are varied acoustically rather than electrically, frequency and sensitivity characteristics are not disturbed.

UNEQUALLED PERFORMANCE

The unique feature that makes Schoeps microphones superior to all others is its patented multiple-pattern, single metal diaphragm construction. Pattern switching is achieved by altering the acoustical chambers behind the diaphragm. This system guarantees the smoothest high frequency response and highest front-to-back discrimination in the cardioid pattern.

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Schoeps microphones are available in two series. The CM 60 series uses a standard 6AU6 plug-in tube. The smaller M221B series (illustrated) features a number of interchangeable condenser capsules. A full range of accessories, including a unique MS stereo adapter, makes Schoeps the most versatile microphone in the world.

Schoeps is the only condenser microphone approved for use by the entire French radio and television broadcasting system.

COMPARE THE SCHEPS

You are cordially invited to try the Schoeps microphone on location or in your own studio. We are confident that you will find the Schoeps system vastly superior to any condenser microphone. Write or phone for a demonstration. Literature is available on request.

INTERNATIONAL ELECTROACOUSTICS INCORPORATED

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AUDIO • JUNE, 1962
it was a simple matter to provide this 19-ke frequency with a 45-deg. phase relationship to the pilot carrier. If this signal then is used for the horizontal deflection of an oscilloscope, with the stereo signal (pilot carrier amplitude = 0) applied to the vertical input, then the patterns illustrated in Fig. 9 will ensue. Incorrect phasing of the pilot carrier will result in the oscilloscope patterns as shown in Fig. 10. Figure 11 shows a correctly phased right signal when the pilot carrier is not suppressed at the composite output. These oscilloscope patterns thus provide a simple method for adjustment and monitoring of the phase of the pilot carrier. The Phase-Calibrate pushbutton removes the pilot carrier from the composite output signal, so that the patterns of Fig. 9 are readily available.

The FM Generator

The basic oscillator in this circuit is a 6AB4 triode with a 6AU6 pentode acting as the modulating capacitance. The circuit is capable of delivering a linear sweep of ±400 ke with only 1 per cent harmonic distortion. The distortion actually measured for a ±75-ke deviation is below 0.2 per cent.

The Meter Circuit

The meter circuit consists of a regular a.c. amplifier with a high-time-constant meter rectifier, which makes it a true peak-to-peak indicator. This is necessary for meaningful indication of a multiplex signal since this complex signal defies the simple rules for normal rms indication of a.c. signals. No fixed relationship exists here between the rms indication and the peak-to-peak volt-

![EXCLUSIVE!](image-url)

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

- Single ball bearing mountings: Minimize lateral-vertical friction.
- An accurately machined and treated walnut tone arm: suppresses extraneous resonances.
- New type wire guide: Tone arm wire can no longer exert drag on the moving system. It moves as a unit on its own axis.
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- Unusually high compliance: at least 20 x 10⁻⁶ cms/dyne, delivers clean, tight bass.
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  - Lowest tracking force: less than 1 gram, renders record wear and distortion negligible.

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- Very low inertia with perfect balance: gives highly stable tracking at low stylus pressure.
- Only 1½" rear overhang: makes installation easy in the tightest cabinet space.
- The side thrust compensator: first of its kind in an American model, helps to maintain even groove wall pressure.

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**AUDIO DYNAMICS CORPORATION**

1677 Cody Avenue
Ridgewood 27, New York
inner-groove distortion

(from page 84)

change being apparent. Two adjustments are provided in the sensing circuits to set the points at which the switch is moved up or down as the voltage across the meter goes too high or too low for any particular range. Adjustment of these points is simplified by the use of a calibrating device which consists of five resistors and two #47 pilot lamps in a bridge circuit. This device is connected to 6.3 volts from a pair of tip jacks at the rear of the instrument and two sets of terminals provide the two calibrating voltages.

Operation

Because of the automatic range selection feature, the instrument has only two controls—the power switch and a "AUTO-SELECT" switch. The latter disables the motor circuit so the instrument remains on whatever step it happens to be on. Thus if one is making a series of measurements of approximately the same value but of intermittent character—for instance, measuring the output of an amplifier while using a standard tape or disc with discrete steps of frequencies separated by silent periods—then the instrument provides a definite convenience to have the switch in the AUTO position and then desires to switch to another range, the switch is simply turned to AUTO until the desired range is indicated.

Fig. 11. Correct phasing of pilot carrier but pilot carrier in composite output signal not suppressed.

If one is measuring a number of voltages in the range of 0-100 volts and desires to switch to another range, the switch is simply turned to AUTO until the desired range is indicated.

It is a definite convenience to have the automatic feature, but even more important is the consistent accuracy of the instrument. With a scale almost four inches in length, the divisions representing 100 microvolts on the 3-mv range are about 0.2/32 in. apart, which makes for easy readability. The input and output terminals are of the standard laboratory type with %

4-in. spacing, and a 4-ft. coaxial cable with clips is supplied as the test lead.

The total time required for the range switch to run through its eleven positions from one extreme to the other is less than three seconds, so the user has no delays because of the automatic feature. And while any properly designed tube voltmeter should not be susceptible to damage from applying, say, 300 volts when it is set on the 3-mv range, it is comforting to know that this instrument selects its own range so it can never be left on a low setting with a high voltage applied for any length of time—which might damage the meter.

One of the first things a new user will want to do with this instrument is to connect it to a program line and watch it drive itself crazy chasing program levels up and down. But once this entertainment feature has been observed, the instrument will then be put to work as a superb device for everyday use—with excellent accuracy and at a reasonable price.
considerably when overhang distance and offset angle are reduced. In fact, possibly only the constant force of arm inertia remains a factor when these two values are made sufficiently small. In the light of the above, the author submits that “inner groove distortion” is unavoidable, but with optimum values of overhang distance and offset angle can be minimized; and that arm “D” is the better choice for the reproduction of modern stereo records.

APPENDIX I

Tonearm Resonance

The resonant frequency of a tonearm is determined by the total mass of the arm versus the combined compliance of the cartridge and the vinyl record material. Since compliance of the record material is fairly constant, and that of the cartridge is normally not controlled by the arm designer, arm mass essentially determines resonance. Undamped resonance in the audio range will increase apparent bass, but will also increase rumble response and upset good tracking. Therefore, one approach has been to place arm resonance one or two octaves below 20 cps. This avoids the two rumble frequencies, 15 cps for the small 3600 rpm synchronous “clock” motors, and 30 cps for the heavy 1800 rpm motors. But placing resonance in the subsonic frequencies without damping it is possibly harmful in that “q” is greater at lower frequencies and any subsonic vibrations introduced into the system may overload amplifiers and cause distortion. An early method of combating this problem was damping of the tonearm pivots with a silicon derivative. This had the advantage that the arm could be literally dropped on the record without doing any harm, but it also caused overly high pivot friction, particularly in the lateral plane. The most recent approach has been to place resonance at a higher frequency and then damp it by allowing the counterweight to resonate at the same frequency. This works on the same principle as the bass reflex loudspeaker enclosure, substituting two smaller resonant hums half an octave on either side of the original resonant frequency. If the chosen frequency is 15 cps instead of 5 cps, then the undamped “q” is lower to begin with, and when the counterweight is isolated from the arm with damping material, the peaks appear at approximately 10 cps and 22 cps. Dips in response will appear at both fundamental rumble frequencies, making 15 cps an extremely logical choice of damped resonant frequency.

TAPE REVERSING MECHANISM

Transformers and the power supply are mounted on the control chassis below the delay relay. The upper right plate contains the latching relay and thermal delay relay. On the right, below the relaying motor, are mounted the transistor relay, \( K_a \), and relay \( K_b \). At the bottom, near the center, are the two switching solenoids and head-selection switch for the 4-track heads. The box at the lower left contains the 2-track or 4-track selector switch. Reversing relay, \( K_a \), is mounted within the main chassis just below the d.c. power supply.

Power and connections to the transistor circuit and relay are made through feedthrough terminals at the lower portion of the deck. (See Fig. 1.) The manual reversing switch is mounted on a bracket adjacent to these terminals. Flexible leads transfer the power to the transistor circuitry terminal board mounted upon the tape tension rack assembly, which moves up and down by the action of the tape-drive control lever. At the opposite end of this rack, near the capstan, there is an “L” shaped metal pull-down hook that automatically pulls the tape away from the heads during fast reeling. The oxide-contacting surface of the hook utilizes a glass rod. (See Fig. 8.)

The additions, mounted on the front of the tape deck, are enclosed during normal operation. An additional tape guide was placed to the right of the reverse playback head to help align the tape travel during reverse play modes. The Nortronics TLB-2 4-track stereo heads are used on a specially fabricated bracket. The bracket was constructed to allow adjustment in three planes. These particular heads require a magnetic shield to reduce induced hum flux. A metal magnetic shunt plate was positioned to distort the hum flux to the minimum value for each head. These were mounted on the pressure rack and pressure roller arm to allow automatic retraction during reverse and threading operation.

Another variation would be to install a second photo cell set at the right side of the mechanism, or logic circuitry with the present device, to automatically place the playback mode bank into the forward direction for repeat of the complete tape program. Thus, if 10½-in. reels were used with 4-track information on ½-mil Mylar tape, it would require over four hours of playing time before the program material would repeat itself when played at the speed of 7½ ips. All that is required for this feature is
RADIO MAGAZINES, Inc. is pleased to announce the acquisition of Communication Engineering and of the Communication Engineering Book Company, both formerly of Monterey, Massachusetts, and beginning with the January, 1962, issue will continue the publication of the Communication Registries which have been published continuously since 1944 by Milton B. Sleeper. These Registries are published as a service to engineers, consultants, company and public officials, operators, and equipment manufacturers in the communication field. Communication Engineering Registries are published quarterly, each one covering a specific group of services. The information is provided in two sections, as follows:

Part I. Listing by names of licensees showing:
1. Name and address of licensee.
2. Location of fixed transmitter.
3. Number of mobile and portable units authorized.
4. Operating frequencies of fixed, mobile, and portable transmitters, including relay, operational, and control transmitters.
5. Call letters.
6. Make of equipment used.

Part II. Listing by operating frequencies shows:
1. Operating frequency.
2. Location of transmitters.
3. Service for which operation is authorized.

Additional information on each transmitter and its location can be found by referring to the listing by names of licensees.

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<th>1962 REGISTRY OF INDUSTRIAL SYSTEMS, PRICE $7.00</th>
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<td>STL for Radio Bscq.</td>
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<th>1962 REGISTRY OF PUBLIC SAFETY SYSTEMS, PRICE $6.00</th>
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<td>Forestry Conservation</td>
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<tr>
<td>Special Emergency (Relief Organiz.</td>
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<tr>
<td>Ambulance, Doctor, Vehicular, Ambulances, School Buses</td>
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<td>Ambulances,</td>
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<td>School Buses</td>
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to effectively place the latching relay back into the forward mode. Momentarily switching $S_3$ to the STOP 1963

RECORD REVUE
(from page 48)

reasonable seems to plenty of people who like their $\phi$ and their culture in a package. He’s a grand old man, still buffetting the categories, still turning out new things in new ways, mostly unexpected. Columbus takes them all in stride.

The two most recent releases, celebrating the 50th anniversary, are definitive Stravinsky performances of his ballet scores. "Firebird" is done here in the 1917 original scoring, which Stravinsky himself was involved in, though he wasn’t at his youthful archetypical tricks in it. The playing isn’t at all Stokowski-like and, indeed, the more casual and unpretentious of consecutive scores that join up the formal dance sequences are surprisingly dissonant.

Also generally rather fragmentary for continuous listening, minus the visible ballet action, an authentic, authoritative recording, this one, beautifully detailed in its portrayal of the complex score though it is not perhaps the most idealistic potential of the score, is the real Stravinsky."Petrouchka" is in the leaner, more precise revision 1947 orchestration, which Stravinsky clearly is no longer "amateurish" longer than the original! A matter-of-fact admission on his part, entirely realistic from his own high-level viewpoint. It’s more of a continuous spectacle, this complete ballet score, though essentially the continuous connecting passages still are a part of its style.

The 1961 "omnibus" record isn’t so complex as it looks in print; a number of the works are very short. The fantasy "Histoire du Soldat" suite takes up one whole side; the spirited "Jazz," the Beethoven profile of the Sunday music, is one major work on the reverse, the other being the second "American" with piano. First heard in 1960, applying serial thinking to various aspects of musical structure.

Bartok: Three Village Scenes (1917); Music for Strings, Percussion and Celesta (1935).

Budapest Radio Orchestra, Choir, Lehel.

Westminster WST 17004 stereo

"New" Bartok has been appearing often lately; the three short movements of these Village Scenes are a major find, music of wide appeal with their folk tones sung by a woman’s chorus and occasional soprano solo, set in a variously effective sort of dissonance-1917 style—that will facilitate any ear trained for it. Marvelous orchestral effects, including the major third "in OM" which you’ll find in Bartok, via a non-stop trombone in the three piece.

His are masterpieces of folk music. To this day, Bartok is the only top-rank composer to have found a dissonant idiom that is so easily settling for folk illusion without distorting the folk-style material values. Aaron Copland is perhaps a close match because he Americans, tone-setting in such works as "Rodeo," "Old American Ballad" and, in particular, Bartok’s "Satyrs" for more sophisticated ear.

The difficult "Music for Strings, Percussion and Celesta" is Bartok’s "Western" dissonance does not seem to have been the Hungarians from turning to him in recent years especially the national muscle here. The readings is excellent, too, produced by an appreciation all Hungarian team under West cylinders."
When the system is first switched on it will go to this position because the capacitor connected to the base of \( Q_{14} \) will delay the flow of base current until \( Q_{12} \) has run off and seized control.

Now we start to move the anode potential of the diode \( D_{14} \) negative. The anode is at about +2 volts and once we go negative beyond this point we start to drive current into the base of \( Q_{13} \). The emitters of both \( Q_{12} \) and \( Q_{13} \) start to move negative so that the current through \( Q_{12} \) begins to drop. This is enough to produce regenerative action through the resistance coupling the collector of \( Q_{12} \) to the base of \( Q_{13} \), and the circuit switches to a state in which \( Q_{12} \) is on and \( Q_{13} \) is off. The current when \( Q_{14} \) is bottomed can be some 2½ milliamps compared with about 0.6 ma when \( Q_{12} \) is bottomed. The result is that the emitter of \( Q_{13} \) goes negative and drives \( Q_{14} \) hard.

When \( Q_{14} \) bottoms it clamps the base of \( Q_{13} \) in the regulator circuit down to the zero voltage line and, just to be sure, pulls the bases of \( Q_{12} \) and \( Q_{14} \) down to zero voltage through the diodes. In consequence all these transistors are cut off and only a small leakage current can flow through to the load. This is quite a safe condition, for the transistor diodes is being held on by excessive current until it takes off.

My impression is that this system is completely safe. It was set up with an automatic short-circuit system which puts on a complete short-circuit at the terminals, removed it, re-set the system and started again. I have now forgotten how many tens of thousands of times the system was operated but really after the first few hundred times the only point in going on is to provide material for an advertising department. The control system is easily adapted for use in other voltages and at lower currents. If you expect to use a unit of this kind at full current and maximum voltage for prolonged periods on really hot days I should be tempted to mount simple bimetallic thermostats set to, say 60-deg. C on the heat sinks right next to the power transistors and use the contacts of these to switch the base of \( Q_{13} \) down to zero level if the transistor overheats.

This is not a constructional article, at least not one of those detailed descriptions of exactly where to drill every hole and mount every component. When I was ten years old I learned to get along building circuits with the components I had, not the ones in the book — the economic child in a non- affluent society. Now I believe that if you propose to build a system like this, which may cost several weeks of a teacher's pay for components and a good many hours to assemble and test, you ought to spend a couple of hours making sure you really know what you are doing. Failing that, earn some money doing something you understand and, after you have paid your taxes, buy a power unit.
Maintaining Hi-Fi Equipment
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A valuable reference for anyone whose living or hobby is servicing hi-fi equipment. Outlines the professional approach for servicing all types of hi-fi components. Covers trouble-shooting of electronic, mechanical and acoustic problems. 224 pages. No. 58 Paperback $2.90*.

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Recording Level

Q. In copying a stereo tape I have been told of different methods of setting the record levels. Should I set both record levels at the same number? I have been told that I should set each level meter so that the needle of the VU meter just goes up to the red. In other words, I might be setting the left channel at No. 8, the right channel at No. 5 and the preamplifier channel level at No. 4. It seems to me that parts of the soft music might be amplified too much.

A. In recording—whether copying a tape, disc, or radio program—you don't go by the numbers as a rule but by the indication of the record level indicator; in your case, by the VU meter. Otherwise you may get substantially different recorded levels on each channel. The pointer should go up to, but not into, the red region on signal peaks; at average levels it should be 10 db or more below the red region.

In a rare case, it may be intended that the level should be different on each channel. If you know this to be true, you might then go by the numbers; whichever channel in louder should cause the meter for that channel to go up to the red region on signal peaks, and you would then see to it that both gain controls are set to the same number. But the presence of specific knowledge that one channel should be appreciably louder than the other, your aim should be to set the recording gain control on each channel so that the maximum level is the same on the two channels. Should you subsequently find out that you have made a mistake in doing so, this mistake can be corrected in playback by reducing the volume on the appropriate channel. Such a mistake has an advantage: it maximizes the signal-to-noise ratio on the channel that you have recorded at too high a level.

The foregoing statements assume that the record-level meters for the two channels are properly calibrated so that they give the same indication for the same recording level.

Location of Tapes

Q. Would it be harmful to tape music from a player to another amplifier, tuner, or preamplifier because of the transformers in these components?

A. It is taking an unnecessary chance to place recorded tapes near any body which produces a magnetic field, such as the power transformer of an audio component. The magnetic field tends to erase the tape, especially the higher frequencies. In the case of an unrecorded tape, the transformer might leave some kind of hum imprint when it is shut off. It would then be necessary to make sure the tape is adequately erased before recording on it, especially if you had left the tape near a transformer as powerful as that in a stereo power amplifier. Conceivably, although not too likely, the hum imprint might be so strong that the erase head could not erase it completely, requiring a bulk eraser instead. Tapes have a certain amount of memory, and it is possible that something which you think has been adequately erased by the erase head may record with enough strength to become barely audible.

Monitor Phones Impedance

Q. Q. I own a **** preamplifier, **** power amplifier, and 8-ohm tape recorder, as well as two turntables. I wish to use earphones so that I can listen to music from any of the signal sources. The manufacturer of the tape recorder states that 8-ohm phones should be used. I have been told by someone else that I should use phones having several thousand ohms impedance. What should I do?

A. The impedance of the headphones depends upon the point at which you plan to pick up the signal. If you are going to pick up the signal at the output of the power amplifier, then phones with an impedance in the vicinity of 8 ohms would be correct. If you plan to pick up the signal at some point prior to the power amplifier output, then an impedance of several thousand ohms is imperative to prevent loading down the signal and causing excessive distortion and signal loss. Thus if you wish to obtain the signal at the point in your pre-amp which feeds the tape recorder, an impedance of several thousand ohms is necessary; the same holds true if you plan to get the signal at a monitoring point in the tape recorder. On the other hand, 8-ohm phones might be used at the latter points if these are fed by a suitable impedance-matching transformer.

Finding Old Tapes

Q. Is it possible to obtain a stereophonic tape of "Toccata for Organ," Sonotape 5W28041? This tape was released in 1936 or even earlier. I have been unable to find a copy in Chicago and I wonder if you could suggest any sources of supply or information on the content and artists on the tape. I believe this was a two-track tape and I am hoping that it was released on four-tracks.

A. I am hopeful that a reader of this column could assist me by sending me the information you desire; if so, I shall immediately forward this information to you. In the meantime, following are a couple of suggestions. Dubbings Sales Corp. may have had a hand in the production of the two-track version of the tape you are seeking. Dubbings now goes under the name of Scott Instrument Labs, and you might query them. The address is 226 Franklin Avenue, Hewitt, N. Y. You might also query United Stereo Tapes, 88 Llewellyn Avenue, Bloomfield, New Jersey.

Audio June, 1962

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NEW LITERATURE

- Hi-Fi & FA Catalogues. University Loudspeakers has just announced the availability of two new catalogues: one covering the company’s high-fidelity product line, and one covering their public address products. The high-fidelity products catalogue entitled “Your Guide to Component Stereo High Fidelity” is a 26-page brochure describing all of University’s high-fidelity components and includes a complete guide to component stereo high fidelity in general. The guide tells the prospective hi-fi purchaser how to choose and appraise components, compares component price to cost, and includes complete “do-it-yourself” information for those who wish to design and build their own speaker system. The public address catalogue is 12 pages and includes, besides detailed product descriptions, much helpful application information on using drivers, transmitters, paging-talkback speakers, sound columns, and hi-fi speakers for PA use. Either catalogue is available free-of-charge. University Loudspeakers, White Plains, N.Y.

- Stereo-Hi-Fi Brochure. A 3-color brochure which allows easier reading because of its hold open format, Altec’s 1962-63 stereo high-fidelity brochure, AL-180-3, details its high-fidelity product range from microphones, tuners, amplifiers, speakers, and speaker systems. Featured in the brochure is the new 708A “Astro” AM-FM multiplex tuner-amplifier. Also included is an illustrated section covering recommended stereo component arrangements. Altec-Lansing Corp., Anaheim, Calif.

- Condensed Tube Catalogue. Amperex Electronic Corp. announces a new 25-page condensed tube catalogue intended to serve as a quick reference guide for design engineers of new equipment as well as for replacement tube. This new Amperex catalogue contains a numerical index, descriptions and basic specifications on the full line of Amperex tubes. Free copies may be obtained by writing to company stationed in Amperex Electronic Corp. Adv. Dept., 240 Duffy Ave., Hicksville, L.I., N.Y.

- Auditionary Sound Systems. Model specifications for 14 types of sound systems suitable for auditoriums and other meeting places with capacities ranging from 300 to 2000 seats is made available in a brochure entitled “Structured Sound” by the Radio Corporation of America. Audio-Visual Products Marketing Group. The systems provide a choice of high or low-level sound distribution in schools, churches, and other public places and can be installed in most cases by independent contractors and radio-TV servicemen. Radio Corporation of America, Menlo Park, Calif.

- Electronics Data Handbook. A revised and enlarged edition of the Allied “Electronics Data Handbook” containing an up-to-date listing of most commonly used tables, formulas and other reference material has just been published. It is edited by Lt. Cdr. Nelson M. Cooke, USN (Ret.). New data and the revised edition includes: basic transistor formulas and symbols, common-emitter and amplifier circuit figures, and vacuum tube characteristics; a transfer radiator and mercury battery interchangeability guide; charts showing direct interchangeability between American and British tubes; the latest Greek alphabet designations and translations, information on db gain and loss and attenuator network formula. All referenced materials in earlier editions has been retained including: log and trig tables; EIA and military color codes; transistor amplifiers, and characteristic data; most used electronic formulas and approximations, plus a basic electronic technical reading. The handbook contains 86 pages and is priced at $25 postpaid in the USA and is available from Allied Radio Corporation, 100 N. Western Ave., Chicago 90, Illinois. Ask for the Electronics Data Handbook (Catalogues #23K30).

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SALE ITEMS—tapes—component parts. Brazil, Box 132, Wanikag, N. Y.

PROFESSIONAL PROJESTIO SN console disc recorder, amplifiers, cutting heads, automatic equalizer. Good condition. Trade for Amplex $40 or 245 2-track stereo Concertone, or Presto tape recorder. John Price, 11819 Lipman Road, Dallas, Texas.

WANTED: Olsen transformers, 2 Presto SD or SG disc recorders, Sound Stendals, 230 N. Michigan, Chicago, Ill.

MAN, LONG EXPERIENCED hi-fi installations and alignments for professional position. New York area. Box CP-1, 3rd floor.

SELL: Two Altec Lansing condenser microphone systems (2H1), new condition $100 each. Matched pair, excellent for stereo recording. V. R. Holm, 418 Gregory, Rockford, Ill.

WANTED: Fisher AM-50 AM tuner or 90-M AM-FM tuner, Harry Pukau, 202 Janaville Place, Detroit 14, N. Y.

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Industry Notes...

- Tommey Acquires Control of Gotham Audio
- Stephen J. Tommey formerly a 50 per cent stockholder in Gotham Audio Corp. has acquired all of the outstanding stock interest formerly held by H. Michael as of February 23, 1962. Mr. Michael, who is in Hollywood, California, represents Gotham's imported products in the greater Los Angeles area under an agreement between the parties. Gotham Audio handles the products of Neumann, Beyerd, Lyrecht, Bogen-Germany, Yamaha and many others. H. Allen Selby III has joined the Gotham Audio staff in a sales capacity to assume the duties vacated by Mr. Michael. Mr. Selby was previously associated with Radio Shack Inc. of Boston and Lang Electronics Inc. of N. Y.

- Pickering Team Realigned
- The sales and product-planning team at Pickering would be reorganized and re-aligned in a new manner, according to Walter G. Stanton, President. The move coincides with the introduction of a new product line at the May Products Show. Two major personal changes have occurred. C. R. "Bay" Bennett has moved into the sales liaison post as Dealer-Merchandising Manager, and J. E. Flic has become Planning and Product Manager. The new West Coast regional office will be under the direction of "Matt" Mathews. The job of Sales Manager held by George Petelin who recently moved to a sales capacity with Revere-Bounderdorf in Danbury, Conn. no longer exists. The present realignment includes the functions covered by Petelin.

- Norman Sanders Joins University
- University Loudspeakers announced the appointment of Norman Sanders as regional sales manager for New York. Charles Ray, general sales and merchandising manager said Mr. Sanders area of responsibility will be throughout the Central United States supervising the sale of University high fidelity and public address speakers and microphones. Mr. Sanders is a veteran in this field having helped to start the Allegro department at Leonard Radio in 1944. Since that time he has served as Assistant Sales Manager for Pilot Radio Corporation, Sales Promotion Manager for Harman-Kardon, High Fidelity Manager for Liberty Music Shops, and national sales manager of Crosby Electronics.

- Electro-Voice Adopts New Carton Design
- A package design program that has been in progress for over a year recently was culminated with the selection of the Electro-Voice "new look" carton. The successful packaging format submitted by Berger Box Co., Miamisburg, Ind. was selected on the basis of 16 high visibility, clean lines, flexibility, and ability to provide the best vehicle for the E-V corporate image. Don Kirtendall, E-V Adv. Manager explained that the changeover would be done quickly as possible. He said "We want to make it clear to our customers that because a product might come in the old style carton, it does not indicate that the product has been on our shelves for any length of time. This situation would only imply that at the time we had a supply of the old packaging on hand."

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SPECIFICATIONS

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Load Resistance: 60 + 5 ohms
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