AUDIO

JUNE, 1962
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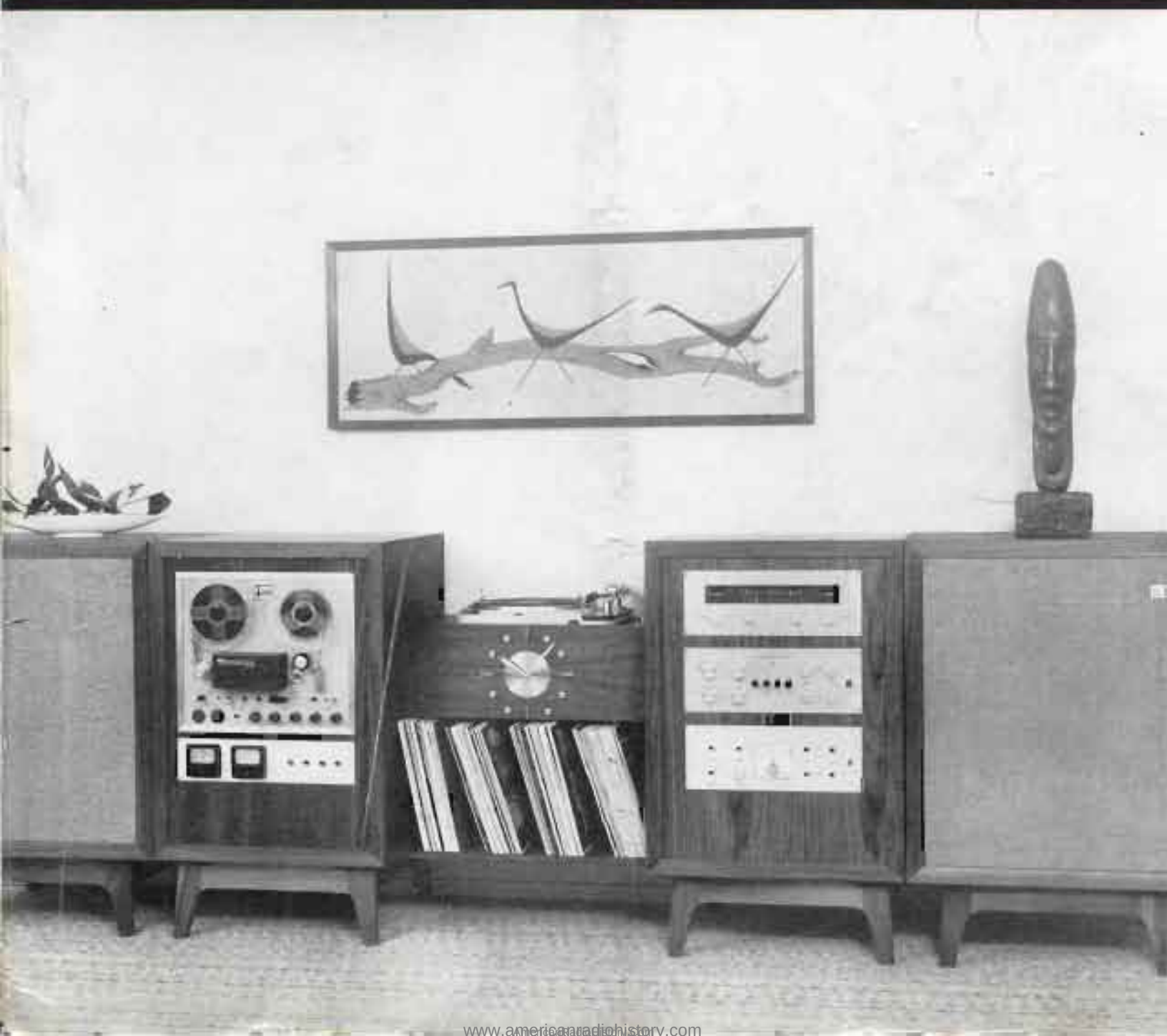

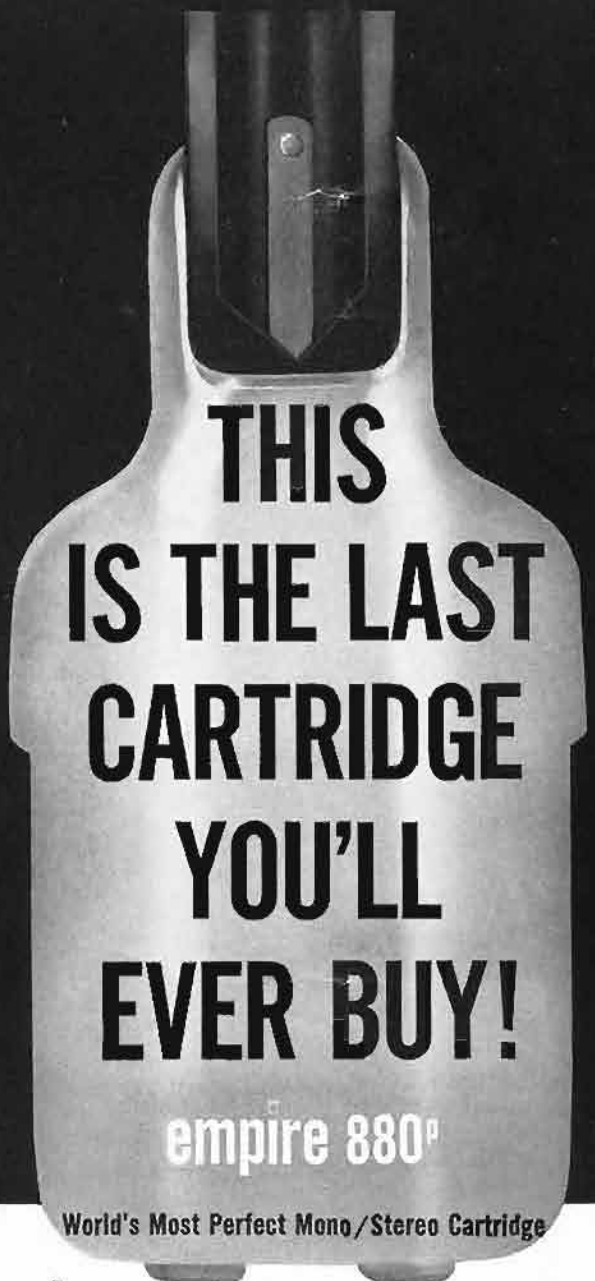

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AUDIO

JUNE, 1962 Vol. 46, No. 6

Successor to RADIO Est. 1917

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AUDIO CLINIC

Joseph Giovanelli

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3420 Newkirk Ave.
Brooklyn 3, N. Y.
Include stamped, self-addressed envelope.

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 20- to 50-μf 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.

Similarly, why not use larger decoupling capacitors (50–100 μf) to improve the low frequency response of the voltage amplifier and phase-splitter stages?

The cathode resistor bypass capacitor of a self-biased output stage should be of such a value as to have a reactance at low frequencies that is "small" relative to the value of the bias resistor. What ratio of capacitor reactance to resistance is "small" and what frequency is usually used as a basis? Edgar H. Berg, Parsippany, New Jersey.

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 reactance of 4000 ohms when the value of 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 as 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 other 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 sound cannot 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 of hard material, often with not even a curtain to act as a sound absorber. (Recording studios are some-

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*DuPont trademark for polyester film

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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 listening 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 three-dimensional 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 noticed 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 as has been described, lending their voices to the general confusion. AE

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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.

For more information write Dept. A-6 Harman-Kardon, Inc., Plainview, New York.

harman kardon

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 inexorably 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 26½ years ago!*

At that time, the internal structure was similar to that reviewed in the December 28, 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. I realize that you could 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 Hegeman, and Herbert Keroes. They are all great in my book.

LEON KIRBY
Sales Manager,
Harman-Kardon

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

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, IHFM, Acoustical Society of America, AIEE, MRIA, SMPTE, 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 IHFM 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.

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 124 with an Audio Empire tone arm and cartridge. The tape recorder is a Concertone, Model 505, 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.

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 browse.)

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.

AR INC. *turntable*

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.

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.

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.

FOR BUTTERFINGERS. 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.

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 12¾" x 16¾" x 5¼".

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.

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LIGHT LISTENING

Clifford Gaddard

Sounds in the Round—Echoes of the Storm
Concertapes 4T—3023

The material on this tape has enjoyed a distinguished career annoying the wives and sweethearts of mono and stereo component fans. When they first appeared on the Audiophile label in the late '50's, this thunderstorm and sounds of the "Crazy Quilt" collection soon became part of the standard procedure wherever good sound systems were subjected to evaluation. It's difficult to say how many times this recording has been used in the past as one of the main arbiters in contests of almost-evenly-matched cartridges or loudspeakers. Certainly in its disc version, "Echoes of the Storm" helped to settle a lot of arguments about the degree of compliance necessary in a good pickup. Many cartridges of the '50's that tracked adequately on conventional records were tossed out of the grooves on Side One of this release. The combined impact of crackling lightning and booming thunder, engraved with far less than normal attenuation, was just too much for their rigid mass. Anyone familiar with the original disc may find this four-track tape version a somewhat less exciting experience during the thunderstorm. After all, the tape playback cannot possibly duplicate the suspense that would creep in while you were wondering if a new pickup would track the groove. While no one will deny that a recording such as this could really use the wider dynamic range of the old two-track stereo tapes, the sound quality of this four-track reel still places it head and shoulders above the average tape being released today. A good deal of the answer lies in the fact that Concertapes, in taking over distribution of the Audiophile label's catalog, inherited some of the cleanest masters in the business. This shows up even on sounds of narrower dynamic range. Whatever your opinion of the capabilities of quarter track, this reel should have some surprises for you. Even if you happen to share my opinion that a good stereo disc has better highs than a four-track tape, most disc fans will have to admit that this particular tape has lows you couldn't crowd into a record groove. The thunder on Track One of this reel will create activity in low-efficiency woofers that seldom comes their way. Treble response is more than adequate for the singing of the rotary saw; the subtle differences in the blows of the hammer driving nails are still there in the high end and the truly virtuoso performance of the guy regulating the flow of the faucet in the water-into-bucket sequence is still a work of art in any medium. Use this reel to cap an evening with your more hardened audio cronies. Anything following it will sound awfully tame.

No Strings (Original Broadway Cast)
Capitol SO 1695

Richard Rodgers, who gave us the scores to "Oklahoma," "South Pacific," "The King and I," and other Broadway classics, has written the first set of lyrics for his own music in "No Strings." During the past forty years, Rodgers composed music for some thirty-seven musicals, most of them in partnership with lyricists Lorenz Hart and Oscar Hammerstein 2nd. Having outlived both of his famous collaborators, Dick Rodgers elected to try something different in a show that would have his own lyrics. The approach in "No Strings" is novel enough to register on records, not an easy thing to do when you're working with sound alone. This show spent two extra weeks on the road during its pre-Broadway tryout tour, visiting Detroit, Cleveland and Toronto in addition to the usual New Haven stop. The production that finally came before Capitol's microphones is an undiluted joy to the ear. Part of the pleasure in listening to this score stems from the fact that Rodgers employed several unconventional ideas in the treatment of the music. No strings can be found in the orchestra. The theatre patron faces more surprises than the home listener because most of the innovations involve the disposition of the orchestra.

Listening to this delightfully fresh score at home, it is quite easy to imagine the orchestra up on stage with the performers—as it is in the theatre. Without the usual curtain of string sound, the other instruments of the orchestra take on new importance and are treated by Rodgers almost as members of the cast. In the hands of a lesser composer, a stringless orchestra could easily rob the singers of support in handling a melodic line or, worse yet, overload the songs with brassy sound. Rodgers actually turns such an orchestra into an asset. Colors normally hidden by strings are used to point up stage action. The carefree atmosphere of the Parisian fashion world is established with the opening notes of the show as a solitary flute imitates the pipes of Pan.

No Strings presents Diahann Carroll in her first starring role on Broadway. She brings rare distinction and fire to the part she plays as a top fashion model in love with a drifting American writer. In the male lead, Richard Kiley turns in his most sensitive job on records to date. The finest duets by the stars are the show-stopping *Sweetest Sounds* followed by *Nobody Told Me*, *Look No Further*, and the title song. The cleverest lyrics crop up in the action-minded *Eager Beaver* and the half-French *La La La* handled by supporting members of the cast. Separation in many of the songs is held to the maximum permitted by the width of the stage. From any angle, this is one of the truly fine shows of the present season and more than ample assurance that Richard Rodgers can go it alone.

Jo Basile: Mexico with Love
Audio Fidelity AFSD 5946

This is not the first time that Audio Fidelity's traveling accordionist has ventured south of the border. Two other centers of Latin song have been visited in separate albums. Rio with Love saw Basile in the largest market place of South American melody; Argentine Tangos covered the crisp rhythms of that dance form in the fifth stereo release of his lengthy series. In the eighteenth release on the AF label, the predictable close-up miking takes us inside the harmonies of Mexico's *El Rancho Grande*, *Cielito Lindo*, *Chiapanecas* and all the other highly-seasoned staples of that country's musical diet. More than a majority of the tunes are brisk in tempo—*La Golondrina* affording the only slow workout for the Basile accordion's low register.

Frank Chacksfield: My Gypsy Love
Richmond Tape RPE 45030

Anyone boasting a varied collection of tapes has probably stumbled upon this listening tip many moons ago. Whenever I sit back to relax with some favored old tapes or compare a batch of new ones, I try to follow the same procedure. If I start with the less impressive reels and work up to the better sounding stuff, the entire session is bound to be more enjoyable than a sequence of tapes running in descending order of merit. The theory seems to work every time. Deficiencies in a recording are twice as noticeable if the preceding item didn't have similar deficiencies. While the same principle applies to a mixed bunch of records, it is easier to spot in the case of tape releases. Forgetting the considerable difference between two track and four, quarter-track tape releases today still show greater variance from label to label than I find on present-day stereo records. In large part, this stems from the sad fact (sad for tape, that is) that it is easier to get full high-end response onto the disc than the four-track tape. Without the extreme high end that all good stereo cutters can put into a groove these days, four-track tapes show up even slight differences in response from label to label.

This Richmond taping of gypsy melodies by Frank Chacksfield would occupy middle ground in a listening session attempting to run the gamut of today's releases. It's certainly better than Chacksfield's early Richmond reels with good presence in all sections of the easily separated orchestra. The true nature of the reel's frequency response becomes apparent only when you follow it with the smoothly extended highs and richer bass of a Chacksfield tape on the parent London label.

All American (Original Broadway Cast)
Columbia KOS 2160

The songwriting team of Charles Strouse and Lee Adams is blessed with better star material in All American than it had in its earlier show, Bye Bye Birdie. Ray Bolger's loose-limbed assets have been an agile fixture on Broadway for many decades. Familiar to recent audiences in scattered television appearances and a movie or two, Bolger is a dance and song man of the old school that held its first classes back in the days of Gus Edwards. Broadway hasn't seen him since the 840 performances of Frank Loesser's hit show "Where's Charley?" a little over ten years ago. The role that lured Bolger back to the footlights seems an unlikely one at first glance but he obviously relishes every moment of his portrayal of a super-square Viennese professor newly arrived in this country. The action of this fast-moving musical, and there is a lot of it, takes place on the campus of an ultra-typical American college. The plot offers no profound insights into our academic way of life nor is it burdened by a point of view that could be described as extremely witty. It's just funny enough to keep the customers amused while Bolger is strutting his stuff. His main assistance in carrying the show comes from Glasgow-born Eileen Herlie, who first caught the attention of show record buyers in her leading role as Jackie Gleason's romantic interest in "Take Me Along." Her voice not quite as tremulous as it was in that earlier album, she's the ideal foil for Bolger's bumbling manner as she combines efficiency and romance in her portrayal of the school's dean. The outstanding songs include *Melt Us* and *What a Country* sung by Bolger and the chorus of arriving immigrants, *Physical Fitness* propounded by the football team and Bolger's *I'm Fascinating* with its built-in dance steps.

Eric Johnson: Ivor Novello's Music Hall
Westminster WST 14134

Waltzing in Vienna
Westminster WST 17010

These two releases are cousins in a family that has seen more flourishing days. Westminster's album devoted to the old-fashioned tunes of famous Ivor Novello shows points up the influence of Viennese operetta in the British theatre of the '30's and '40's. During a period of some twenty-five years, Novello operated a unique one-man production line that turned out a steady stream of romantic shows in the Continental tradition. He was playwright, composer, lyricist, actor and theatre manager in vehicles that claimed one major virtue—nearly total escape from a humdrum world. One of his shows, "The Dancing Years" had a Viennese setting and featured Novello versions of the waltzes that made the city famous. Whatever their locale, the tunes of Novello shows have never lost their popu-

How to test a stereo kit for top performance:

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larity in England. They offer American listeners a change of pace that many may find welcome after a session with some of our recent Broadway composers. The Eric Johnson orchestra turns in a smooth job in this batch of tunes. Johnson's recent album of Fritz Kreisler melodies, recorded for the same label, did not prepare me for the treatment he gives this music. The familiar Kreisler items were almost smothered under very fancy arrangements. Novello gets a much better break in an approach that is commendably straightforward.

Keeping alive the Viennese tradition in Westminster's companion release is no problem for the members of the Vienna State Opera orchestra heard here under the direction of Josef Leo Gruber. Unlike the average release of this type, there is offered here a total of twenty waltzes in one album—many of them familiar only on their native soil. Interestingly enough, the Strauss name doesn't crop up anywhere in the lineup of composers represented on this record, proving that the local scene over there has never been starved for creative talent. Some of the writers who have never been overshadowed by the members of the Strauss dynasty are gradually gaining posthumous fame through compositions that are only being discovered. Lehar and Kalman are the best-known names in a group that includes Komzak, Ziehrer, Fall, Fucik and Lanner. Since no selection is longer than four minutes in duration, this album is an unusual and diverting way to make the acquaintance of the other Viennese waltz composers.

The Coldstream Guards Go West
Riverside 7523

There have been rumors that the Western music of our movies and television shows has been catching on in England but I never expected to hear it played by the band of the Coldstream Guards. Tossing aside its usual dignified march tempos, the musical arm of Britain's senior Guards regiment is the source of one of the more unusual records in recent months as it swings into a varied program of Western origin. The band hews closest to its traditional sound in *The Yellow Rose of Texas*. The mood music of our leading TV horse-opera (Wagon Train, Cheyenne, and Wyatt Earp) gains much in stature in full treatment for band while the Dixieland overtones of a swing version of *Red River Valley* break down the last remnant of military reserve.

Eddie Cantor: Carnegie Hall Concert
Audio Fidelity AFLP 702

With the aid of two pianos and a phenomenal memory, Eddie Cantor brings to life several generations of Americana show business during this appearance recorded on the stage of Carnegie Hall. Never one to pay attention to his age, Eddie cavorts through a collection of songs he made famous as he reminisces about his early years in the business and then proceeds to imitate fellow luminaries such as Jimmy Durante, Ed Wynn, W. C. Fields, and Al Jolson. His imitations may not be the most realistic you've ever heard but his deeply personal insight—combined with the stories he tells—will take anyone over the age of forty right back into the golden era of the American theatre. In these days when group thinking has penetrated so much of the entertainment world, this album is a tonic reminder that the old stars not only prized their individuality—they weren't afraid to exercise it.

Sing-A-Round with Arthur Godfrey
Capitol SKAO 1683

Join Bing in a Gang Sing
Warner Bros. Tape WSTC 1422

The sing-along albums are getting pretty fancy. There used to be a time when all that was needed to stimulate singing on the part of a record audience was an echo chamber hollow enough in sound and a robust chorus of male voices that didn't run its words together. Subsequent refinements in sing-along releases included mixed voices, songs in foreign languages and the use of celebrities at

(Continued on page 51)

AUDIO ETC.

Edward Tatnall Canby

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 in mono and stereo. Indeed, one evening a few weeks ago I nearly strangled myself; I had three sets of phones on my head at once, for an abortive A-B-C- comparison, and one of them with a particularly vigorous set of springs slipped down over my nose 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 *solo* 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 route-planning for the cables) is most sociable and indeed lots of fun, in a curious new way. I do sincerely recommend it.

One person in one set of phones lives in a curious world of his own, the more curious when the source is stereo and the phones are leak-proof. This has been the phone maker's big plug. Listen to hi fi while your wife sleeps peacefully. Sample the Beethoven *Ninth* in the middle of the kids' daily Disney. Excellent idea. But what really is a new sensation is the shared world —two people, or maybe three (three's a crowd?), all fed from the same sound-source, sharing the same thrills and shocks, the same aural misfortunes.

Glubglubblurp

The oddest thing about this shared phone listening is that though the two (or more) people are wholly at one in a delightful way, they cannot communicate with each other. By smiles, shudders, raised eyebrows, knowing looks—yes. But not by words. Strange sensation. "Boy, listen to those piccolos," you say involuntarily to your co-listener; but all he gets is glubglubglubblurp.

I spent several quite lengthy sessions listening in this fashion, just to see what it was like for real, minus A-B tests and with only one thought—the music I was hearing. I came out from under the phones with a very positive feeling that here was something pretty good.

Took me back to the year 1927. In that year I was sent to school in Switzerland, "La Clairière," in Arveyes, Vaud. The proprietor M. André Clerc, who still lives in Arveyes, was an early radio enthusiast and had a fine system installed in the study-hall-parlor where we used to sit in the evenings. Earphones, of course. This was a school, remember, even if it did look like a large private house and act like a private family. So during our evening "quiet period" we had the privilege of listening to Radio Paris ("Rahddyo Paree") or Radio Milano, which broadcast classical music, 'way back in those days, just as our FM good music stations do now. I won't ever forget those communal listening sessions, through the old hard-rubber mono phones. The idea was good then and it is far better now. Tends towards peace and quiet on the outside, and utter absorption inside.

For the man on the outside of a shared phone system, the oddest sensation is to watch the silent listeners, in utter stillness, concentrating inwards with an almost cross-eyed intensity, like a man testing out his ulcers, or savoring a recently injested beefsteak. Then suddenly, all the listeners burst into raucous laughter for a fleeting instant, or groan unexpectedly in consort. Quite upsetting, this, and the outsider soon wants in. The silliest thing of all is the inevitable attempted conversation. The man inside the phones invariably shouts in a voice loud enough to be heard halfway down the block, yet when you answer him he thinks you're whispering. "*WHAT WAS THAT?*" he bellows. Glubglubglubblurp.

2. THE NINETY PER CENT BLEND

All of which is an atmospheric prelude to more atmospheric business—stereo via phones. As can be deduced from the above (I did *not* listen mono), I'm all for phone stereo, at last—with modifications of essential importance. There are only two ways to do the modifying, unless you go out and make your own true-binaural recordings.

One way is already familiar, via the Bauer circuit. That is surely the best way. But, pending a hoped-for commercialization of that circuit, you must build your own Bauer and, unluckily, the choke values as published in this magaine last October are both fairly critical, not subject to much tolerance off the stated quantities, and at present non-commercial. You have to wind your own. I asked Mr. Bauer a few weeks back whether maybe he could look into this very practical difficulty but being a pure-scientist engineer I'm not sure when he'll get around to it. Shall see.

The other method of producing a listenable signal in phones from stereo recordings is ultra-simple, though relatively few people have applied it systematically and intentionally, 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 tore up a 12-page predecessor to this article, delayed the magazine almost two weeks, and am still fascinated 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.

Loudspeaker 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 add increasing proportions of one channel into the fixed volume of the other, rather than going 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 more mono effect, decreasing the stereo spread, until full blend is achieved with the channels in full parallel. Given proper phasing (we take *that* for granted—but wait until you hear my report next month on individual phone systems . . .), we then have a mono signal, emerging from the halfway 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 blending. Let me say, at once, that the effect is remarkably different from that with loudspeakers.

The vital distinction is the one we always are forgetting. Stereo for *speakers* is intended to be heard so that *both* ears receive *both* channels. That's where the loudspeaker placement comes in. Speaker A is heard off to the left, via both your ears. Speaker B is located to the right, via both ears. The modern miracle is that from these two points of spatial information we derive the part-physical, part imaginative "stereo curtain of sound," spread out from side to side.

Via phones, it must be said once more, stereo channel A goes only to *one ear*, the left ear. Channel A by itself, then, cannot be located in space at all. Same with 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 eardrum 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 nerve system, which seems to want two-eared fusion of its sound —all of it. 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 "fi" of the system allows. But when one ear goes silent, instantly the remaining ear hears a loud, jangling, semi-unintelligible noise, horribly distorted. Fade back the second ear and instantly *both* ears hear good sound.

Note a further crucial point. Though balance in level between channels is pleasing, you will find that the earphone sound remains undistorted even with an unbalance between the channel levels—*so long as the two ears have at least a shred of sound to*

9 New Features Now In The New 1962 EICO RP100 Transistorized Stereo/Mono 4-Track Tape Deck

A great tape recorder made greater:

1. **New** professional studio recording hysteresis-synchronous capstan motor: 24 stator slots for ultra-smooth drive, ultra-quiet and vibrationless professional bearing system.
2. Two **new** take-up and rewind reel motors, both extra-powered for effortless operation.
3. **New** cored-out steel capstan flywheel with all the mass concentrated at the rim for improved flutter filtering.
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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 lifters); unequalled electronic control facilities such as mixing mic and line controls, two recording level meters, sound-on-sound recording selected on panel, playback mode selector, etc. Modular plug-in construction.

Wow and flutter: under 0.15% RMS at 7½ IPS; under 0.2% RMS at 3¾ IPS. **Timing Accuracy:** ± 0.15% (±3 seconds in 30 minutes). **Frequency Response:** ± 2db 30-15,000 cps at 7½ IPS, 55db signal-to-noise ratio; ± 2db 30-10,000 cps at 3¾ IPS, 50db signal-to-noise ratio. **Line Inputs Sensitivity:** 100mv. **Mike Inputs Sensitivity:** 0.5mv.

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FM MULTIPLEX AUTODAPTOR MX99 (Patent Pending)
Kit $39.95 Wired $64.95 Cover Optional $2.95

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

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

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grasp at in common. It is only when one phone goes entirely dead that the hideous, jangling one-ear distortion-effect begins.

And a final point. Swing your balance control back and forth. On stereo speakers, of course, your sound-source (either stereo or mono) will seem to move towards one side or the other in proportion to the volume balance. Without question, a major aspect of stereo location (though not the only one) is volume balance, as between related signals on the two sides.

Now try swinging the balance control with your stereo phones. You'll find to your astonishment, if you listen critically, that the location scarcely moves at all, *if* at all. Not until the last bit of extreme unbalance, when one phone is about to go silent altogether, does your sound suddenly migrate from out in space into the jangling confines of one inner ear.

The two ears, in other words, cling desperately to their joint fusion of the incoming sounds. They cling in two ways. First, they cling to a natural, two-ear sound even when one phone is enormously louder than the other, until the association is finally broken by silence in one ear. Second, similarly, they cling to their joint perception of directionality, wherever it may locate the sounds, similarly until the last joint sound-clue is removed via one silent phone.

The demonstration of these things is best in mono. You'll note that the mono sound, which is located (if rightly phased) squarely in the middle of your head, simply will not budge sidewise with decreasing volume on one side. Instead, you merely feel a sort of "deafness" in the ear that has a weaker signal, an increasingly unpleasant feeling as of cotton batting being stuffed 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 distressingly 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 two-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-eared, 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 the 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 to straight mono. On continuous-blend controls, turn all the way around to mono, where the sound suddenly shrinks down and locates itself inside the confines of your cranium, then back off just a bit—you'll discover immediately (as per the above) that a *very* small proportion of 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,* cling 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. Plus, a vital distortion—those one-eared sounds.

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-tiring one-ear distortion is removed, completely.

And since the phase differences that create the sound-space are easily perceived by the ear *even with a large amount of blending,* you can have your cake and eat it too.

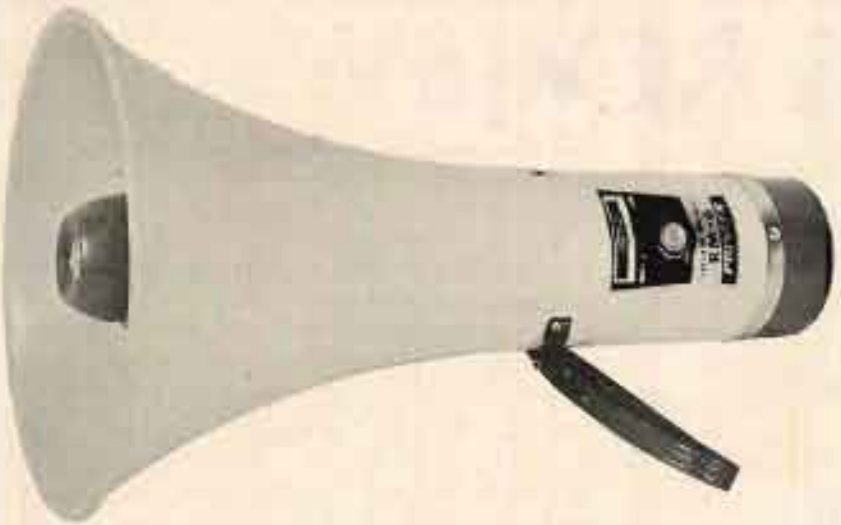
Enough. It works. Just use the Canby Ninety Per cent blend and you can listen to excellent simulated "stereo" space inside your phones for hours, with no strain and a realistic, if unreal, sense of space. After all, no recording of any sort is ever literally real. All good recordings are basically a natural and ear-satisfying (mind-satisfying) *illusion.* If this phone-blend gives us one more type of hearable sound that pleases the ears and satisfies the musical sense, then we have something good. Even without a Bauer circuit.

(The Bauer circuit, in this relationship, not only cross-blends the two channels as here described but does so with artificial phase changes—hence the necessary chokes—that serve to place the two channels actually in perceived space, at approximately the location of the ideal stereo loudspeaker. You think you "hear speakers," virtual-image sound sources. Both ears hear both of them, as in loudspeaker stereo.)

• • • •

It was at this point that I tore up my first article. Because if you begin to examine the actual phase relationships presented to the pair of ears by blended stereo signals via phones, you'll find yourself in a mess of aural complexity. Suppose a lady belts out a tune in Channel One (a faint echo of her in Channel Two) and you blend her 90 per cent into the other channel. Via speakers, she simply moves out into the middle, mainly due to the shift in volume-balance. Via phones, the situation is much more complex. It is not at all easy to "visualize" how the strong signal in Channel One and the weaker and out-of-phase echo in Channel Two work out when cross-blended into

(*Continued on page 60*)



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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.

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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 transformerless) 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.

At Last!

A CARTRIDGE DESIGNED ESPECIALLY FOR AUTOMATIC TURNTABLES!

A NEW KIND OF CARTRIDGE FOR A TOTALLY NEW REQUIREMENT!

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

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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"

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The hermetically sealed STANTON Stereo Fluxvalve is warranted for a lifetime and is covered under the following patents: U.S. Patent No. 2,917,590; Great Britain No. 783,372; Commonwealth of Canada No. 605,673; Japan No. 261,203; and other patents are pending throughout the world.

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.

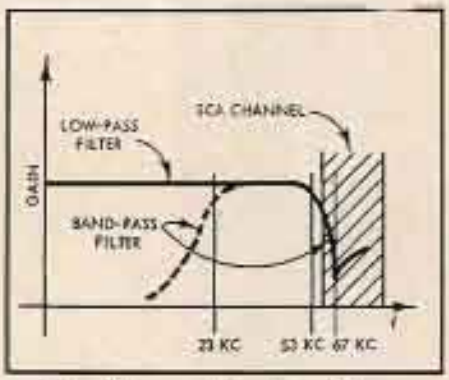

Fig. 1. Low- and band-pass filters.

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

New Fisher Multiplex Generator which provides all the signals required for adapter alignment, both as audio and r.f.

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 effects 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.

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-doubler 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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a. A voltage-variable and accurate 19-kc 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-kc signal in the adapter and connect the horizontal amplifier of the oscilloscope to the 19-kc 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-kc circuit adjustments, switch the oscilloscope to internal sweep and connect the low-capacitance input probe to the 19-kc circuits. Adjust them for maximum output voltage at 19-kc. The 19-kc 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-kc deviation signal, then the 19-kc voltage should be 10 per cent of this voltage, or 100 mv).

e. The probe is then connected to the 38-kc circuits and the oscilloscope is switched to internal sweep input. The 38-kc 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-kc 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-kc 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-kc input voltage for the synchronization test.

Step 3. Optimum stereo separation in adapters is a function of proper 38-kc phasing and correct matrixing. It is also a function of the harmonic, 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.

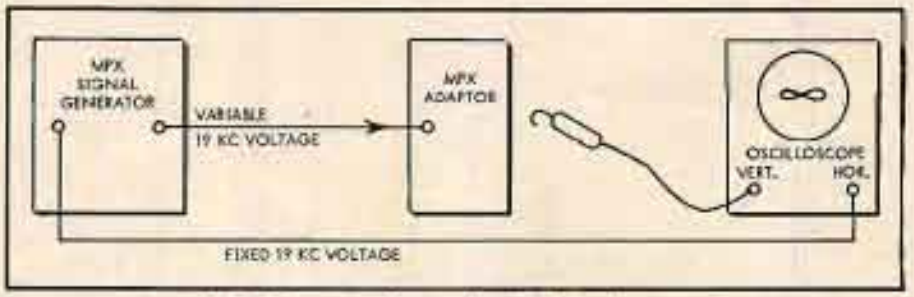


Fig. 2. Test setup for synchronization alignment.

b. Connect VTVM and oscilloscope to left output of adapter. Adjust 19-kc circuits and/or 38-kc 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-cps 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 cps right and 1000 cps left, and all synchronization and separation adjustments are made with this signal connected to the adapter input. The SCA 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-kc circuits and tune for maximum indication on oscilloscope.

b. Connect oscilloscope to right output and adjust 38-kc circuits and/or 19-kc circuits for maximum 60-cps 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-cps signal on 60-cps signal). Repeat b. and c. for best results.

d. Connect oscilloscope to left channel and check for clean 1000-cps 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 multiplex signal 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 it is compact and easily portable.

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

Fig. 3. Lissajous patterns for observing synchronization of 38-kc signal (vertical) with 19-kc signal (horizontal).

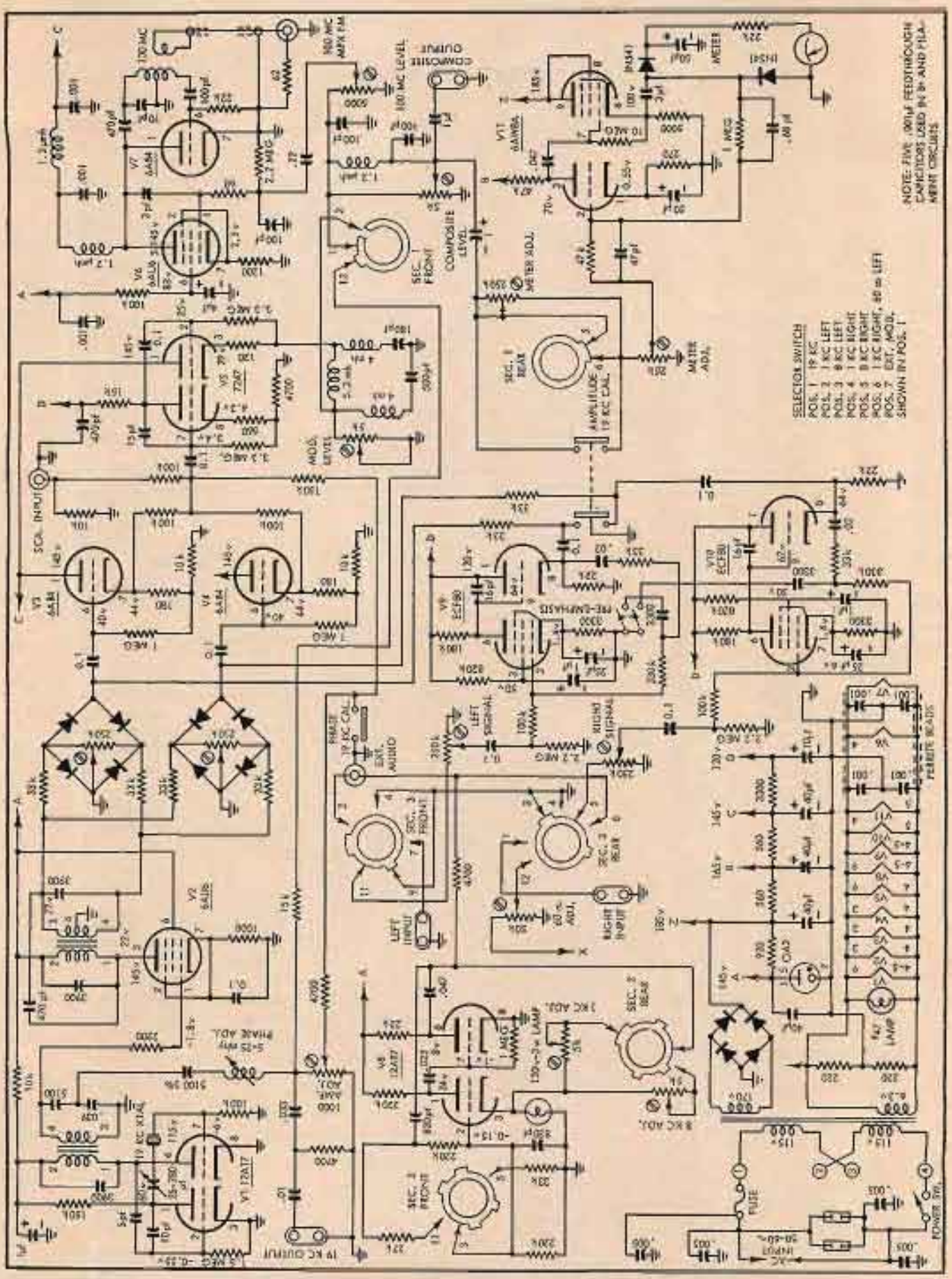


Fig. 4(A). Schematic diagram of the Fisher 300 Multiplex Generator.

as the basic timing mechanism for the signal generator. This oscillator is accurate in frequency to within 2 cps of 19-kc and is virtually free of drift. The 38-kc modulation frequency of the system is derived from this 19-kc signal by means of a frequency doubler. The 38-kc signal is then fed to the modulation unit as shown.

The audio generator provides either a 1000- or 8000-cps (sinusoidal) signal. In addition, a 60-cps 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 8000-cps 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-μs 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 "modulation 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 also connected to a built-in FM 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,

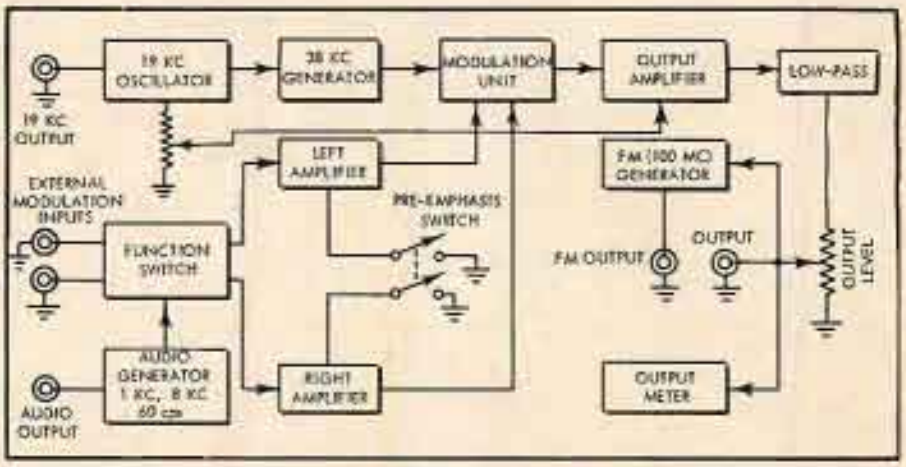


Fig. 4(B) Block diagram.

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 1-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 shorts out 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 wide-band 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 B+ voltage to the voltage-sensitive sections of the multiplex signal generator. It can be connected to either a 117-volt 60-cps line or a 220-volt 50-cps 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.

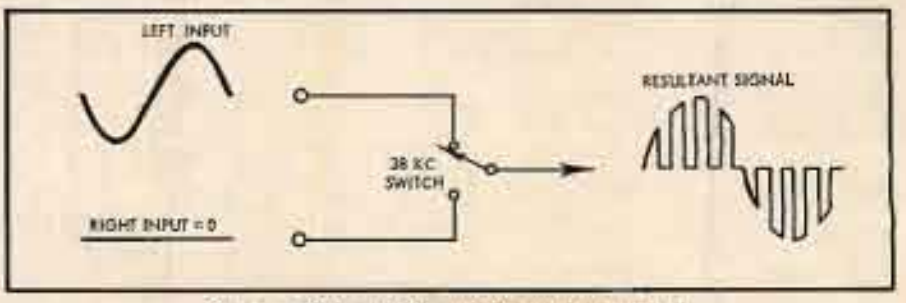
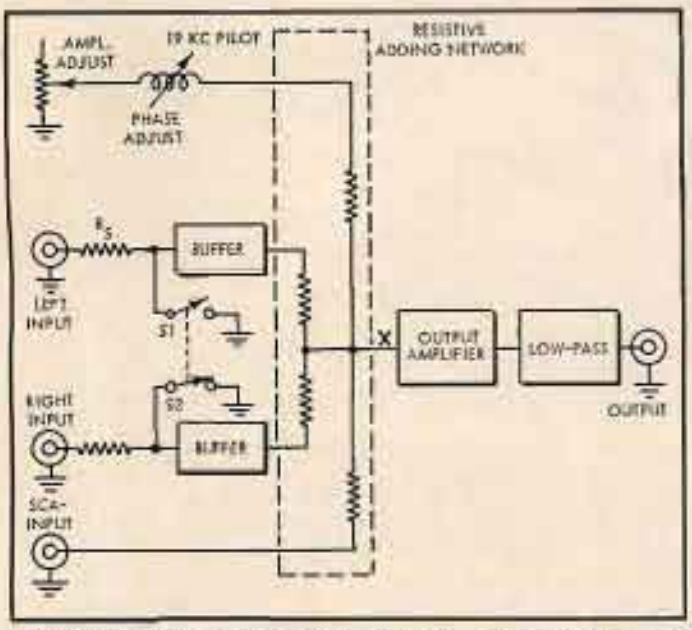


Fig. 5. A 38-kc switch and the resultant signal.



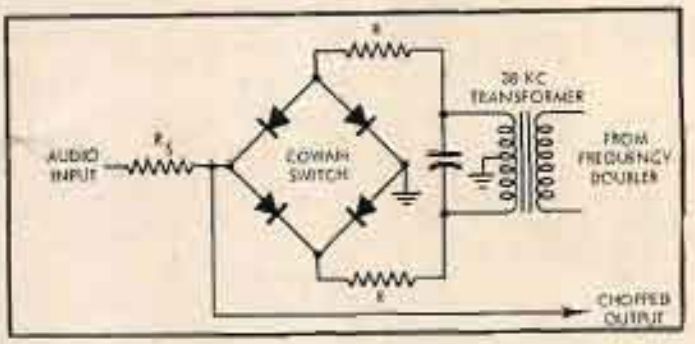


Fig. 6, (left). Block diagram of the MPX modulation unit. Fig. 7, (above). Cowan-type diode switch.

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.

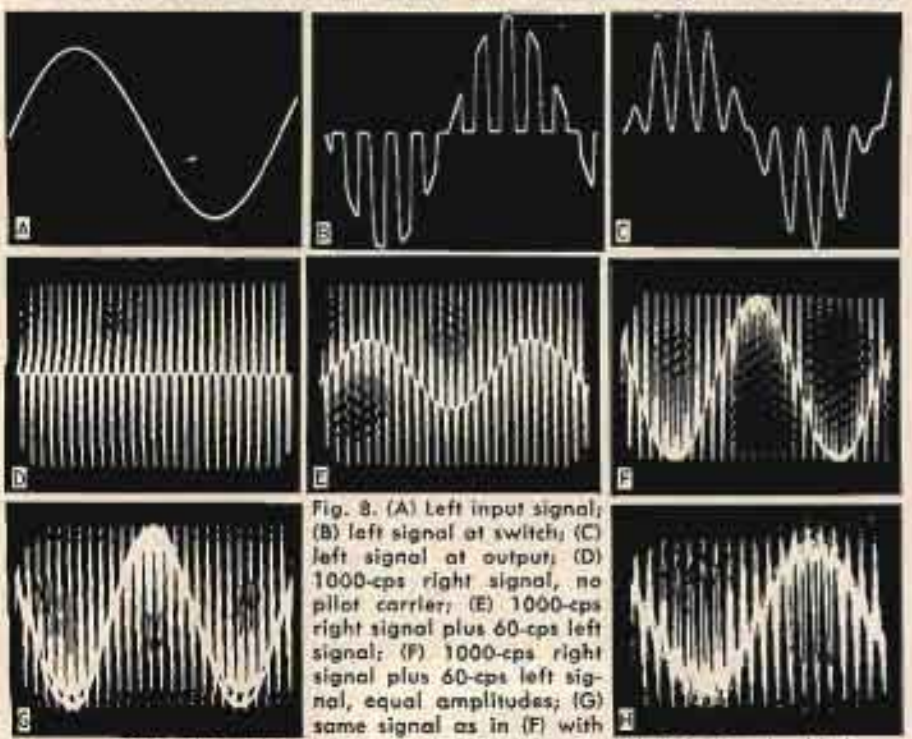


Fig. 8. (A) Left input signal; (B) left signal at switch; (C) left signal at output; (D) 1000-cps right signal, no pilot carrier; (E) 1000-cps right signal plus 60-cps left signal; (F) 1000-cps right signal plus 60-cps left signal, equal amplitudes; (G) same signal as in (F) with 19-kc pilot added; (H) same signal as in (G) with SCA signal added.

The Crystal Oscillator and the Frequency Doubler

A 12AT7 double triode is used for the oscillator circuit. This tube provides ample gain for substained 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 7½ and 15 ips.*
2. *Retain the use of 7 and 10½-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.*

1116 N. 29th Place, Phoenix, Arizona.

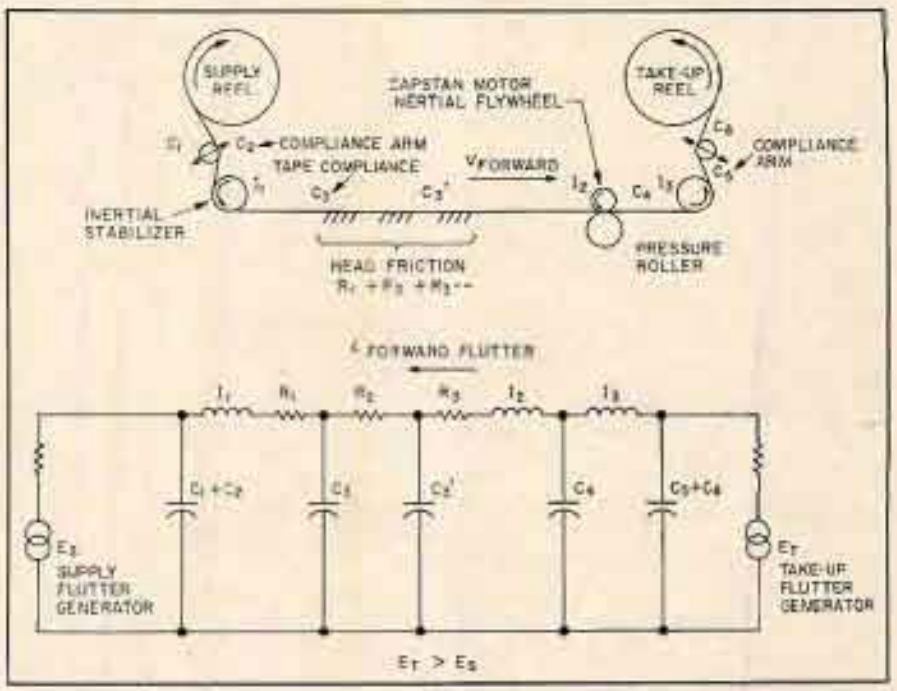


Fig. 2. Mechanical arrangement and electrical analogue for forward direction.

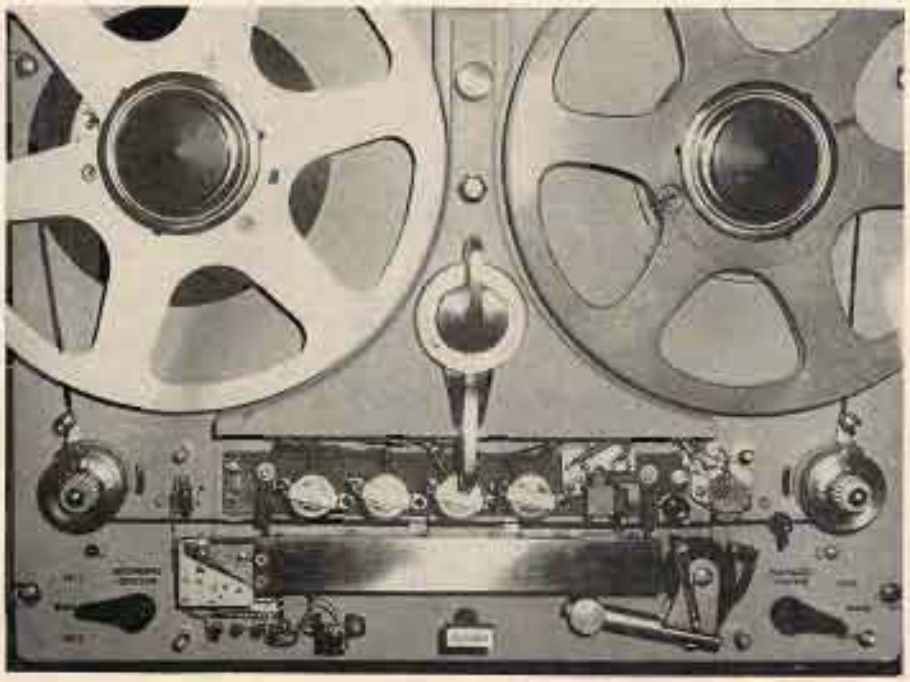


Fig. 1. Top view of tape deck with head covers removed.

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.

The scheme is basically an inertialess 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:

	½-Track	2-Track	4-Track
Record	yes	yes	no
Playback (Forward)	yes	yes	yes
Playback (Reverse)	yes	—	yes
Tape Speed 7½ and 15 ips	yes	yes	yes
Reel Sizes up to 10½ in.	yes	yes	yes
Wow and Flutter: Less than	.15% rms	.15% rms	.15% rms

A. Dynamic electrical braking plus mechanical brake.
B. Automatic shutdown after tape completion or breakage.
C. Selection of either 2-track or 4-track playback.
D. Fast reel spooling, forward and rewind.
E. Automatic reverse mode indication and disable.
F. Automatic forward play reset.

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 ¼ 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 (a.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,

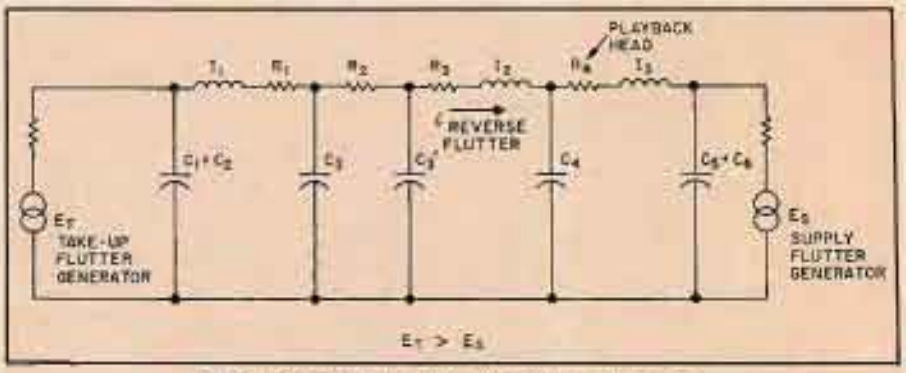


Fig. 3. Electrical analogue for reverse direction.

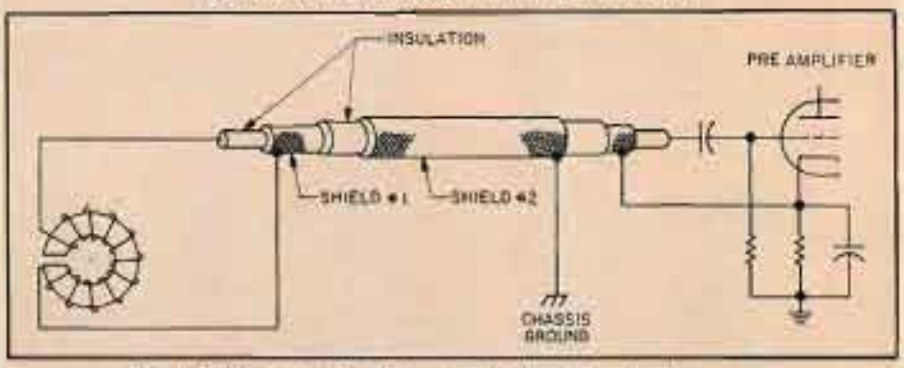


Fig. 4. Cable connection between playback head and preamp.

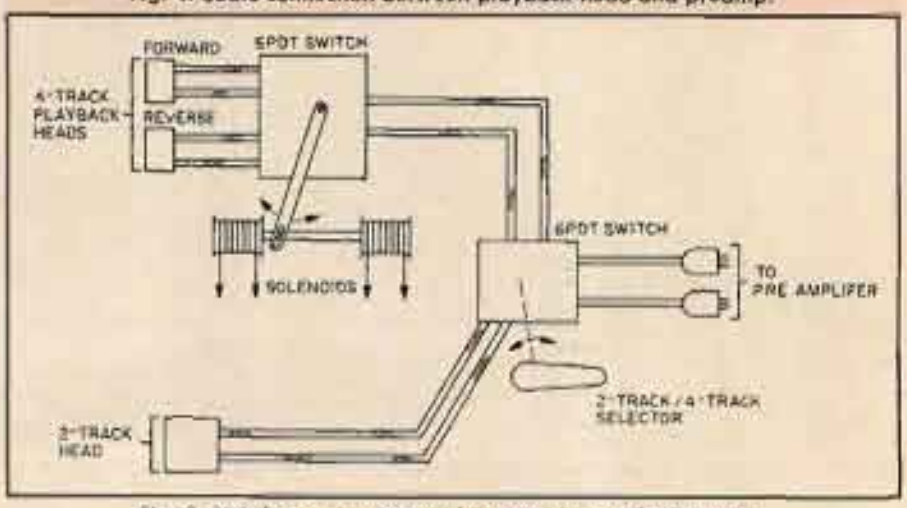


Fig. 5. Switching arrangement between the playback heads.

to reduce the flutter current, the ideal place for locating the reverse playback head would be at the point R_B to benefit from the series components, I_1C_2 and I_2C_1. This fact was proven quite dramatically when the head was placed at this location (as against the initially tried location near R_2)—the reduction in flutter was considerable!

The original control circuitry needed only minor changes to accommodate the reverse-direction mode. Essentially the forward-play circuit remains unchanged, retaining the feature of a transient boost of current through the take-up motor for the first four seconds to overcome the starting inertia. This is achieved by the action of relay K_1 and the discharge of the 80-μf capacitor. Also, the cutoff switch (for end of tape or breakage) and the fast and slow capstan motor-speed switches remain the same. The heavier lines in the schematic diagram indicate the original wiring.

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, latching relay K_6, which remembers whether the mode is forward or reverse play.
2. The sensing 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_{10}.
4. The power supply for the transistor circuit and d.c. braking circuit which is automatically removed by the time relay K_1.
5. The solenoids, K_8 and K_9, for selecting the proper playback head by the associated 6PDT rotary wafer switch.

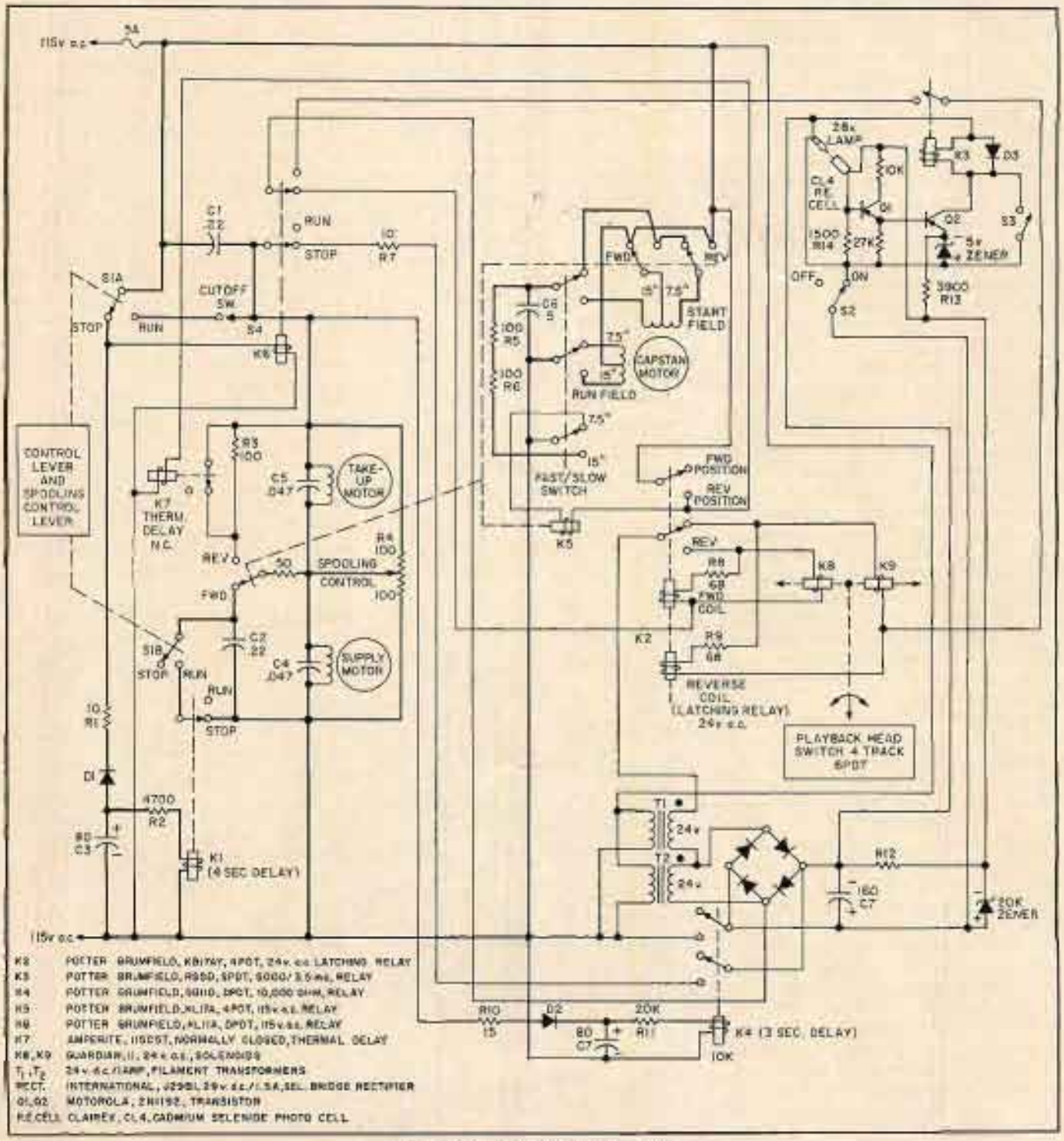


Fig. 6. Schematic of control circuit.

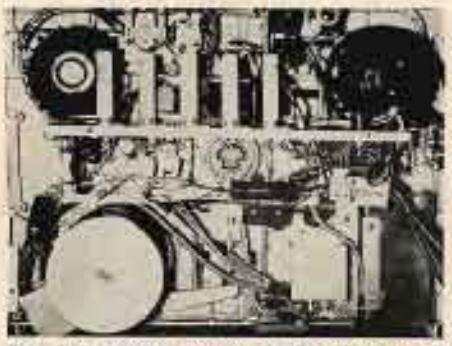


Fig. 7. Bottom view of the deck with chassis cover removed.

When the line voltage is first applied, the latching relay, K_3, will be in the forward (tape direction) mode either initially or automatically by the action of relay K_4 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 memory latch, maintains all forward relays and solenoids in the correct forward direction mode. When the tape-drive control lever is placed into the RUN 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_3 is used to energize the transistor relay, K_3, 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_4 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_3, closes which immediately places the latching relay, K_4, into the "Reverse" memory position; 2) Simultaneously the reverse solenoid, K_{2b}, 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_3 and R_6, for the 24-v. latching relays.

After the final selection has been completed, and the tape completely rewound, tape tension no longer causes the cutoff switch, S_2, 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_{1A}, and simultaneously applies 35 v. d.c. to these motors by the energizing of relay K_5. 115 v. a.c. also is removed from the normally energized relay, K_4, and, after a 3-second delay, capacitor C_7 discharges below the relay threshold removing the d.c. from the reel motors. The time constant comprised of C_7 and R_{11} determines the delay time. The series resistor R_7 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 $10\frac{1}{2}$-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_{18} to limit the diode current. The Q_1 base resistor, R_{14}, is adjusted for holding the relay open under ambient light conditions and proper relay closing dependent upon the lamp intensity. The diode, D_3, across relay K_3, is a surge-current protector for Q_3.

The SPDT switching of the 48-v. a.c. potential by relay K_4 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 playback-head cable 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 6PDT 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.* 7.) The upper left plate comprises the time-delay relay circuitry K_4 and associated rectifier and capacitor-resistor time constant. The

(Continued on page 57)

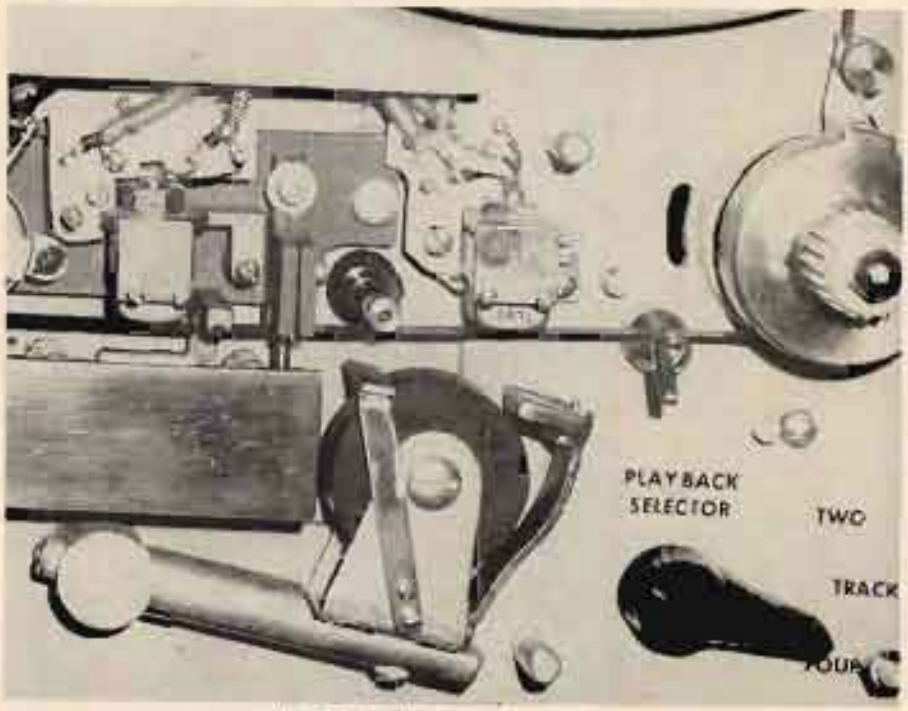


Fig. 8. Detail near capstan motor.

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. *(He did!* ED.)

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. This is fairly easy to produce. In a shunt regulator we think of the supply as a current supply and connect across the load, across the supply outlet, that is, a transistor which is driven in such a way that it takes all the ripple alternating current and leaves only the direct current for the load. 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.

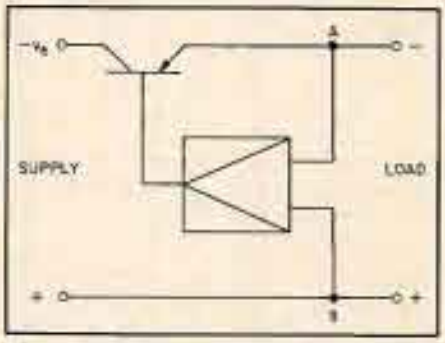


Fig. 1. The basic circuit of a series regulator.

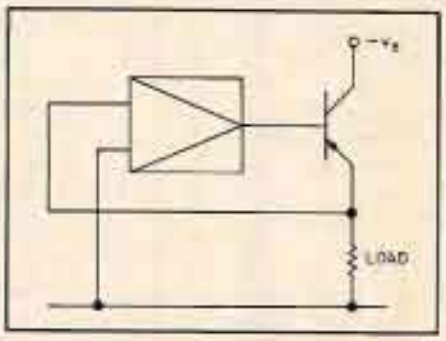


Fig. 2. The circuit redrawn as an amplifier with grounded-collector output and the full negative voltage feedback.

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 deg. 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 $(1+\mu\beta)$). The trouble here is that the transformer secondary must carry 30 amps and we cannot afford much phase shift at 100 or 120 cps 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 rapid changes corresponding to ripple, 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 $1/Gm$ 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 r_s 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 only get 50-μv ripple across a ½-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

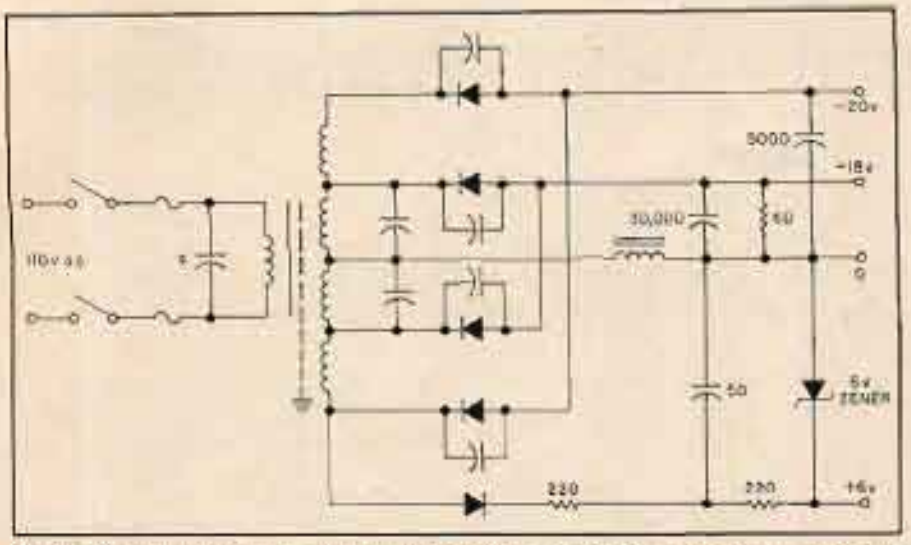


Fig. 3. The basic supply unit. The grounded shield and the diode capacitors, all 0.5 μf, are for protection of the rectifier against supply surges.

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 transistors 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 18 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. × ⅛-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 $0.83/LC10^6$: with $L = 1$ 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 milliamps. 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, Z_2, 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

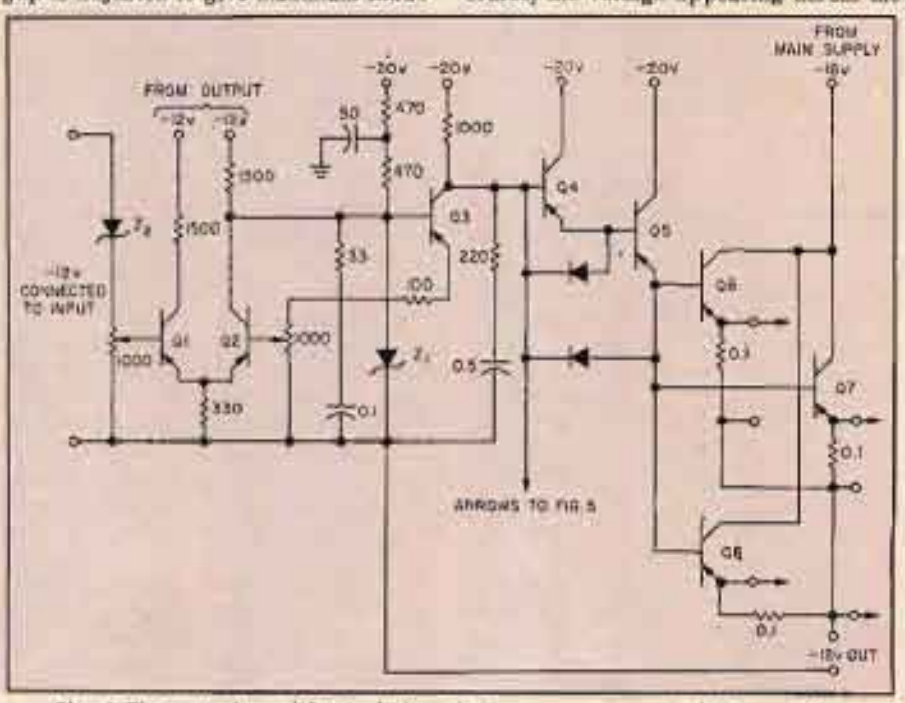


Fig. 4. The control amplifier including the two response-control RC networks.

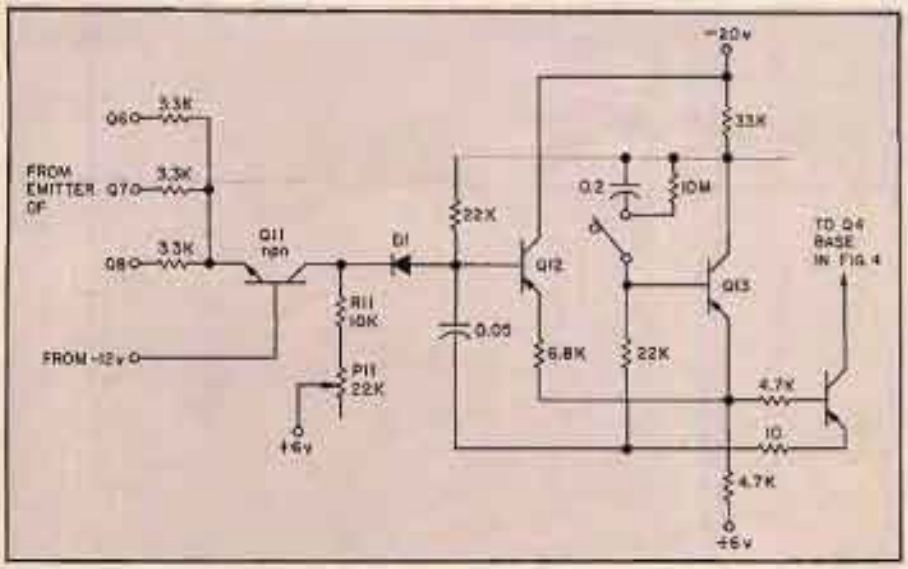


Fig. 5. The safety switch.

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_1. The long-tail pair is a differential amplifier and provides, at the collector of Q_2, 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_3 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_3 will be about –8 volts we return the bottom end of the emitter resistance of Q_3 to the zener diode, $Z_{1,}$ which gives us a constant potential. Q_3 can pass up to about 15 ma and is thus rather larger than Q_1 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_3 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_3. Two features of interest are the diodes at the bases of Q_4 and $Q_{5,7,8}$, 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.

Having reached the point where we have a basic power unit and a regulator system we can examine the behaviour of the whole equipment. A variable load which will take up to 30 amps is needed and we begin at some convenient low current, perhaps 10 amps. We check here that we can vary the voltage over the range from 11 volts to 14 volts by means of the voltage control and we examine the ripple. At this current level we should have no difficulties. As we continue the tests at higher currents we may find that at one end of the voltage range or the other the ripple starts to rise very rapidly. This means that an amplifier transistor is overloading and, as it either bottoms or is cut off the gain drops and the feedback becomes ineffective. It is then necessary to trim the setting of the potentiometer in the base of Q_2 and to restore the voltage by the potentiometer in the base of Q_1. Several of the low-level sections have been made and no further changes have been found necessary: if any trouble should be experienced it is clear that a small amount of sine-wave ripple, say 10 mv, can be injected at the base of Q_1 and can be traced through the amplifier to see where the overloading is taking place.

With a supply unit of this kind the need for protection, both for the supply unit itself and for the equipment it is operating, becomes very important. Fuses are not really fast enough although the new high-speed fuses can do a lot of good. However we may be running at 10 amps when the equipment under test heads toward thermal runaway. If 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 $Q_{6,7,8}$. 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 across 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 +6 volts if no current is flowing in Q_{11} and will go negative from +6 volts by the IR drop in R_{11} and P_{11}.

The pair of transistors, $Q_{12,13}$, form a bi-stable switch. When Q_{11} is conducting, the drop in the collector resistance brings the base feed to Q_{13} down to a very small value, while Q_{12} is forced into bottoming by the regenerative action.

(*Continued on page 59*)

4310 Wide-Band FM Multiplex Broadcast Monitor Tuner

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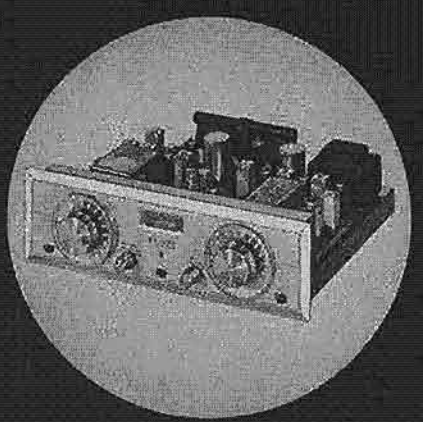

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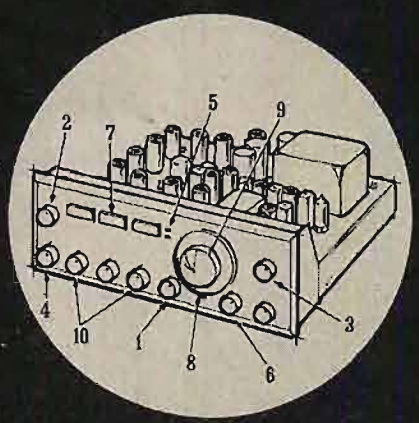
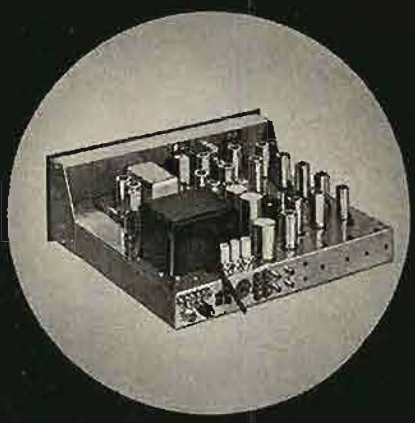


Professional front panel controls: 1. Stereo Threshold. 2 Multiple Diversity. 3. Precision Step-Type Level. 4. Stereo Selector. 5. Automatic Stereo Indicator. 6. Interstation Noise Suppressor. 7. Precision Signal Strength and Tuning Meter. 8. Logging Scale. 9. Main Tuning Dial. 10. Separate Level Controls for each channel.



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Inner-Groove Distortion

R. S. OAKLEY, JR.

In which modern tonearm design trends are examined, and some thoughts about the tracking error problem are offered

THERE HAVE BEEN many new developments in tonearm design in the last year to cope with the ever-improving stereo cartridge.[1] 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 audiofan's 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 3×10^{-6} centimeters/dyne, cartridges with a compliance of 10×10^{-6} 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 3 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.

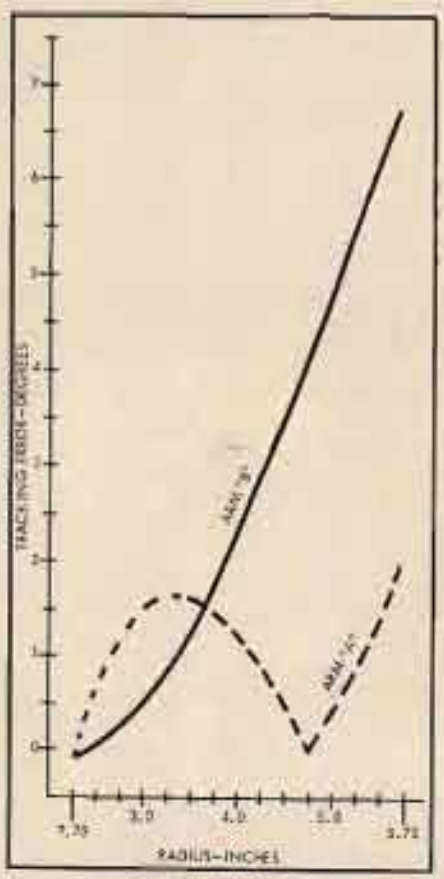

Fig. 1. Comparison of tracking errors between arms of newer type, "A", and older, "B."

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 attention to 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" arms 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-

* *62 Buxton Road, Bedford Hills, New York.*

[1] Joseph Marshall, "New Pickup Arms for Stereo," *Radio Electronics*, November, 1961.

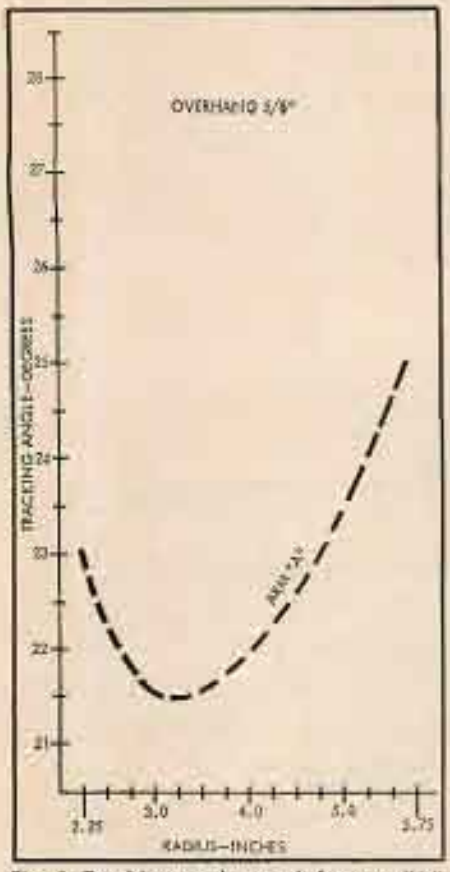

Fig. 2. Tracking angle graph for arm "A" of Fig. 1. With offset angle of 23.1 deg., error is never more than 2 deg., and a minimum in the center grooves.

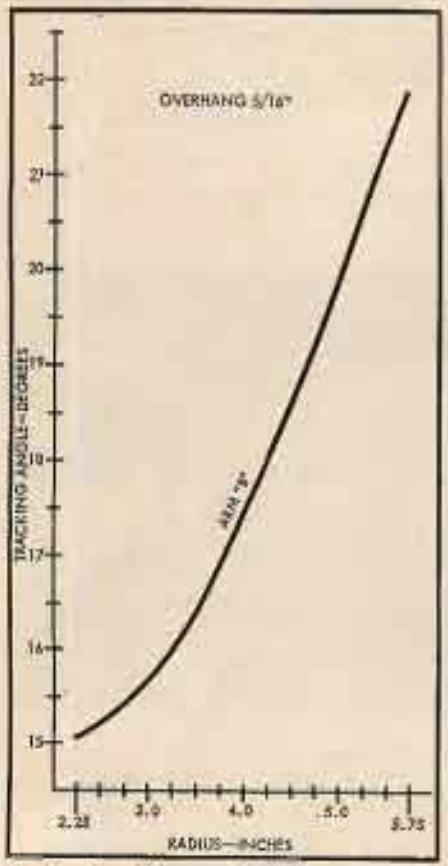

Fig. 3. Graph for arm "B" shows a maximum error of 6.8 deg when used with an offset angle of 15.1 deg.

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 in 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.[2] 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 replotted 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 5/8 in. and that the tracking angle curve is parabolic in shape with a maximum tracking angle 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. produce "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.

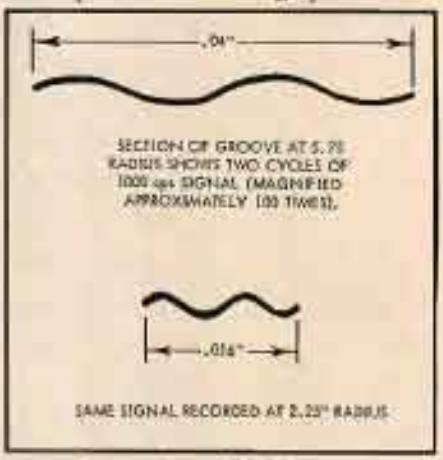

Fig. 4. Comparison of 1000-cps groove at different diameters.

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 dis-

(Continued on page 58)

[2] See Appendix I.

[3] Niel Malan, "Determination of Tracking Angle in Pickup-Arm Design," Audio, February, 1960.

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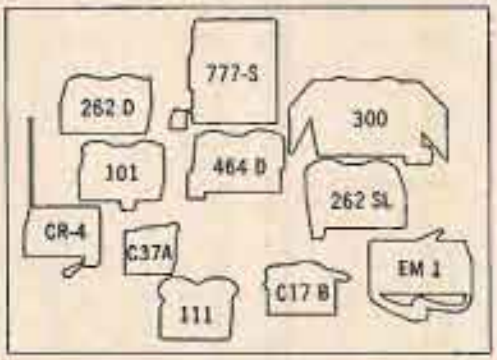

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SUPERSCOPE *The Tapeway to Stereo*

EQUIPMENT PROFILE

LEAK "SANDWICH" LOUDSPEAKER

We first became aware of this new Leak product through reports in several British publications. 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 sometime, 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 ⅝-in. thick are stiffened internally by a coating of thick bituminous material (*see Fig.* 2)

Fig. 1. Leak "Sandwich" loudspeaker system.

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 ⅜-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 front of the cone from the rear. About ½-in. cone travel is achieved. Free-air resonance of the unbaffled woofer is 20 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 ⅜-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 200 times. The point of

Fig. 2. Cutaway view of Leak speaker system.

all this is that many of the dips and peaks that we normally experience in the mid-range have been eliminated.

Performance

Those of us who have listened to loudspeakers manufactured in England, and indeed from Europe in general, have noted that the Continental and British gear favors a tight bass much less florid and rich than the low end of American-built systems. In addition they seem to prefer a very smooth high end which is underplayed in relation to the mid-range. In essence their speaker systems seem to reflect the stereotype of the Englishman: solid, natural, and definitely understated. In reality, this is a clean sound, perhaps more so than in many of our speaker systems.

Within this context, the Leak "Sandwich" Speaker is a superior unit. It is especially fine and smooth in the mid-range and upper mid-range. It is definitely worth listening to if you are in the market for a speaker system. **P-28**

PICKERING STEREO CARTRIDGE, MODEL U38/AT

The Pickering Model U38/AT is a Stanton Stereo Fluxvalve with a white body and black stylus assembly. In common with the other well-known Stanton Fluxvalves, the Model U38/AT features an easily interchangeable stylus assembly plus that familiar but well proved body

Only these FM Stereo Receivers have Pilot's unique signal-sampling multiplex circuit*

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

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Fig. 3. Pickering stereo cartridge, Model U38/AT.

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 Miracord 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 newer 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 from 6 grams up) 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 beside the other Stanton Fluxvalves. 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 which was the range of our measurements). Channel separation at 1000 cps was 34 db and the output per channel was 10 mv (2 mv/cm of recorded level). One of the outstanding features of this cartridge, if it is true to its line, is unusual ruggedness—a real work horse. In our estimation this cartridge is just what is needed by the automatic record player.

F-20

KNIGHT-KIT A.C. V-T VOLTMETER WITH AUTOMATIC RANGE SELECTION

Measuring the characteristic of audio equipment requires the use of a variety of instruments, depending upon the parameter to be measured, but without question the most important is the a.c. vacuum-tube voltmeter. To measure frequency response one needs a signal generator and a voltmeter; to measure distortion one needs a signal generator, some form of filtering, and a voltmeter; to measure hum and noise, one needs a voltmeter; to measure power output one needs a load resistor and a voltmeter. The audio signal generator comes a close second to the voltmeter, but in starting a home lab—or a professional one—the first instrument required is an audio-frequency voltmeter. And one of the first requirements of this important instrument is that it be accurate, consistent, and repeatable; while 1 db does not seem to be a great variation, it still represents approximately 10 per cent.

The simplest a.c. voltmeter consists of a d.c. meter movement, a rectifier, and a calibrating resistor—which is just what a VU meter is. But full-scale deflection of a standard VU meter is approximately 1.74 volts (such meters are calibrated so that without a multiplier, the 0-VU point is 4 db above 1 milliwatt across 600 ohms, which is 1.228 volts, and the full-scale indication is 8 db above the zero on the scale). Many measurements require much greater sensitivity than this—for example, the output from a phono cartridge, which is likely to be anywhere from 5 to 20 millivolts maximum. Furthermore, the impedance of the standard VU meter is 7500 ohms, which is too low to permit measurements in grid circuits.

Consequently, some form of amplification is needed, together with switching facilities so that a range of voltages from around 1 millivolt to, perhaps, 300 volts can be accommodated readily. Obviously, the easiest way to obtain adequate amplification which will remain constant over changes of line voltage and the aging of tubes, considerable negative feedback must be used, not only for these reasons, but also to provide accurate indications over a very wide frequency range.

Heretofore, instruments with all of these characteristics were available only in laboratory grades and at prices far too high for the average experimenter—no matter how serious—to fit into his budget. The Knight-kit 83YU608 vtvm, from Allied Radio Corp., fulfills all of these requirements at a reasonable price—a bit over $100—and in addition automatically selects the proper range and indicates what range it is set on. *Figure* 4 shows the external appearance.

Circuit Details

The Knight-kit vtvm consists primarily of a three-stage amplifier (with 30 db of feedback) which feeds a bridge rectifier circuit which in turn actuates 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 actuates a small d.c. motor to turn the range switch to the next step higher in sensitivity whenever the voltage goes below 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. Preceding 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. One other 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 50 cps to 500 kc, or ±1 db from 20 cps

Fig. 4. Knight-kit a.c. vtvm, Model 83YU608.

Fig. 5. Chassis view of Knight-kit automatic voltmeter.

to 2.5 mc, while the amplifier output is within ±1 db from 20 cps to 1.5 mc at an output impedance of 4000 ohms. The instrument is calibrated to indicate the rms value of a sine wave and the average value of any other wave form. Size is 10¼-in. high, 7-in. wide, and 11¾-in. deep, and weight is 13½ lbs.

Another form of the instrument employs the same metering circuitry but is manually operated in the conventional manner. This model is 83YU978, and costs $30 less.

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 voltage is well regulated with a two-stage amplifier controlling two triodes as series-type regulators. Plate supply voltage varies less than 2 volts over a 20-per cent change in line voltage.

Construction is simplified by the use of three 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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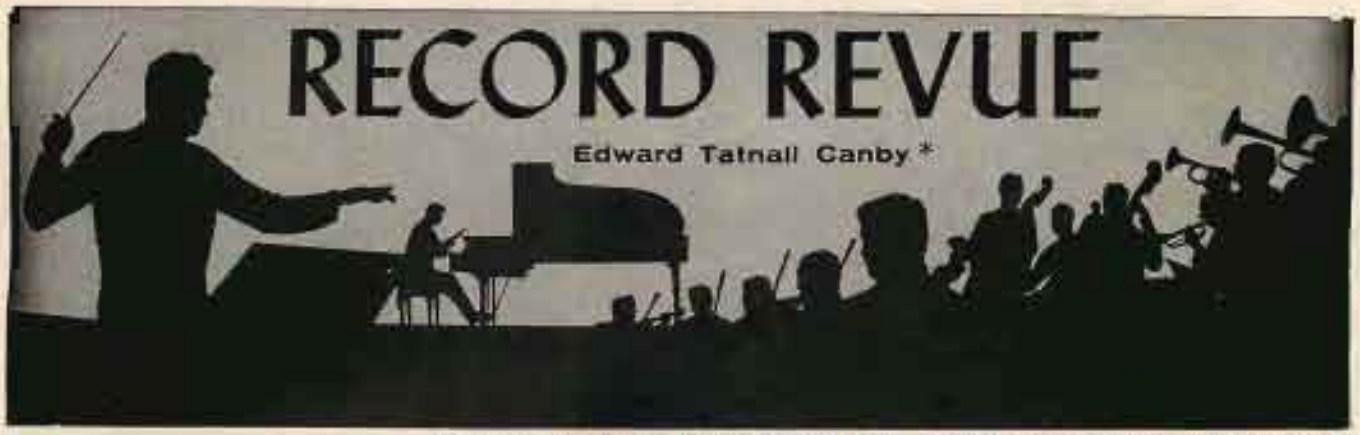

RECORD REVUE

Edward Tatnall Canby*

¡Bravo Toro! Banda de Corrida de Cadiz, Valdez.
Quarante-Cinq 45002 stereo
(45 rpm)

Darn it! It took me weeks to get to this innovation because I don't have a 45 rpm player hanging around any more. I finally played it via the input to my Ampex broadcast recorder—in 45 mono. Only one channel available. But anyone who has a standard record changer will be able to produce the proper sounds without any trouble. Twelve-inch, small center hole.

The new company ("Quarante-Cinq", pronounced Karrnt Sank, means 45 in French) has a brace of valid points, I guess. Sure, the quality can be superior with a groove cut at 45, at least in the inner groove areas of the standard big disc. Yes, most LPs at 33 are now quite short (who sits with a stopwatch to time them?) and thus the "limited" playing time of the twelve-inch 45 in practice isn't so different from the usual LP. (By the same token, I must point out, the short LPs generally produce very little trouble in their inner grooves—and the long ones won't fit on 45, anyhow.)

Here's a 45 sample, an authentic bullfight orchestra from Spain, minus bull and minus crowds. Quality seems jes' fine, but I found the music by itself pretty dull. The trumpet keeps blowing flinkers.

EN AVANT, VANGUARD!

(Note: The Vanguard Recording Society, Inc. is one of our few all-purpose small companies to remain successfully independent. Here is a heartfelt, though unpremeditated salute to the best—and the worst—on a versatile label. E.T.C.)

Machaut: Notre Dame Mass.
Perotin: Viderunt Omnes; Sederunt Principes. The Deller Consort, instr. ensemble.
Vanguard BGS 5045 stereo

This is a splendid and important recording, though not the first for either Machaut, of the 14th century, nor Perotin, the great master of the "old art" of music at the turn of the 12th century. What distinguishes these exciting performances of the oldest church music in parts that we have—out of the Gothic period—is not so much style, which is always problematical in such anciently obscure relics, as the dedicated musical vigor and accuracy with which the four men and their instrumental cohorts produce this quasi barbaric yet immensely complex and sophisticated art.

From beginning to end, this is no historical exercise but a full-fledged performance of living music, though it is of a sort most listeners will not have imagined to have existed.

The earlier Perotin is at the dawn of polyvoiced music; the tunes of a chant are enormously stretched out, each held for minutes (organum), while a powerfully dissonant web of vigorous, short phrases is woven around and about in rapid motion. The Machaut Mass, the first individually composed work of the sort, is more sophisticated, the counterpoint already elaborate in the independent voices; but the intervals are still largely dissonant, the vocal progressions, often in octaves and fifths, at first astonishingly "wrong", until the sinewy sense of these constructions begins to tell on the ear.

Both works breathe the Gothic spirit; both are part and parcel of the Gothic cathedral itself, that combination of immensity and infinite detail, of soaring strength and grimacing ugliness (as in the gargoyles, or the dreadfully realistic sculptings of hell-fire).

Through recordings as convincingly musical as this, we can begin to see that music was, indeed, as alive in the Gothic time as was stonework, even though its traces were far less enduring in the preservation.

Schönberg: Pierrot Lunaire (1912). Ilona Steingruber; Chamber Ensemble, Gosschmann.
Vanguard VDS 2108 stereo

A noble and worthwhile effort, this, to record one of the landmark works of Twentieth Century music with its controversial and almost impossibly tricky "Sprechstimme", a vocal part half-spoken, half-sung.

It was an important experiment and, ideally performed, it remains a most effective piece for soprano solo and a colorful group of sparely dissonant solo instruments. The Surrealistic text, exploring a weird clown-world subconscious of the French, is of a sort that is deliciously familiar to all of us, though in 1912 it must really have seemed a nightmare.

There is lively dissonant counterpoint throughout, somewhat Impressionistic to be sure and brightly colored everywhere. Technical powerhouse devices—fugues, canons, passagaglia, the inevitable Schönberg waltz, in no way thicken up the lightly transparent texture. Indeed, for many this is the one Schönberg work that can be accepted wholeheartedly for its musical expression without the heavy burden of "message".

Ilona Steingraber sings the solo part more than she speaks it. The old version with Erika Stiedry-Wagner on ancient Columbia was, I think, in better style.

The Virtuoso Harpsichord, Vol. 2. Francois Couperin "le Grand." Anton Heiller, harpsichordist.
Vanguard BG 619 mono

At first thought it might seem unwise to pick an outstanding Austrian harpsichordist to play this very specially French music. But harpsichordists are a tight clan with rigorous standards of style and scholarship among themselves, the requirements of their instrument even superceding the demands of nationality. The music itself, centering upon the 18th century, is an aid to such an attitude, for the clear-cut nationalisms of that period were precisely superimposed upon an internationalism that embraced most of the European art.

So—like every good harpsichordist (and very few pianists), Heiller knows the Couperin literature and is expert in the elaborate ritual of keyboard ornamentation it requires. The high-style music, so gentle and staple in its tunes, so incredibly ornamental in detail (like the costumes and the art of the period) is no problem at all for him in the technical sense.

Only, perhaps, a certain conscientiousness of approach, an accuracy that is almost—but not quite—methodical, betrays a mind that is not French itself. It's a pleasure to listen to Couperin via Heiller.

The Silver Swan. (Gibbons, Byrd, Pilkington, Ward.) The Deller Consort.
Vanguard BG 624 mono

(This came to me in mono—and as usual, I'm not clear as to whether it was a clerical slip, there being also a stereo version, or whether it is in mono only. Ask your dealer.)

Alfred Deller is a superb musician with a unique voice, if an eccentric one. The Deller Consort, under his direction, is an oddly conventional group in which his voice stands out uncomfortably by its very difference. The singing of the group, unlike his own in solo, tends here towards excessive vibrato and consequently obscured pitch; chords that should be crystal clear in their simplicity are instead those now-conventional masses of fiddling vocal vibration that we expect in operatic ensembles, more properly there than here. The listening ear, though convinced of the sincerity of these singers, may be in doubt as to just what they are singing—what notes, what chords, what rhythms.

Just why Mr. Deller goes in for this basically unmusical sort of ensemble (anything that is musically ambiguous to the ear is basically unmusical) is beyond me. The old English Singers of years ago, the Golden Age Singers on Westminster, represent a more familiar British tradition of a good, intelligible ensemble blending.

Moreover, the interpretations, notably of the slower works, seem newly eccentric and out of the sense of the music. The famed "Silver Swan" of Gibbons, a piece of the most limpid beauty, is taken at an exaggeratedly slow crawl, so vibrato-ridden that the marvelous Gibbons harmonies are scarcely understandable. Why?

Let me keep this criticism on a proper level—Deller remains a fine musician and his singers do nothing so gross as to sing in a flat or out-of-tune manner. The trouble is not with their ears, but in the vocal sound itself, plus the Deller penchant for well-intended over-Romanticizing.

I should add that the microphone raises its questionable head here. A close-up recording of such a group can, as I know to my own cost, produce an effect of poor ensemble that is exaggerated beyond the actual sound. Perhaps the Deller Consort suffers from ill-advised microphoning.

Bach: Cantatas No. 31 "Der Himmel lacht!," No. 70 "Wachet, Betet." Felbermeyer, Kmentt, Meyer-Welfing, Wien, Berry, Foster; Akademie Choir, Vienna State Opera Orch. Prohaska.
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 wobbly Akademie

Choir in the choral portions—you can't go wrong here, though as in all cantata performances there are moments of less than ideal realization of the now-difficult music. Somehow, the Akademie's multiple vibrato does not often seem to annoy; the fine musicianship and earnest sincerity behind the singing (plus the solid instrumental support in this sort of music) makes the sense clear, the somewhat heavy Austrian approach seems appropriate in the listening; one is grateful for the absence of the driving dynamics heard in U. S. performances.

Purcell: Four Suites for String Orchestra. Chamber Orch. of the Hartford Symphony, Fritz Mahler.

Vanguard BGS 5032 stereo

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

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

Only the performance is wrong—very wrong. Here is the old, pre-"authentic" style of playing, dating back to the turn of the century and apparently handed down to Mr. Mahler and his musicians unchanged, via music-right blinders—as if nothing had happened in the last fifty-odd years! Outrageously wrong "French" dotted figures, played à la Stokowski. That old-fashioned conviction that all such "ancient" music, when rapid, should be played with a pounding, marcato beat, minus phrasing, banging along like so many heavy freight cars pounding the rails. Ugly ritards ending with a mannered "ugh", out of the Eighteen Nineties.

Let's say quickly that those who aren't particularly conversant with "old" music (on a hundred thousand or so records) will probably be unpained by these anachronisms and thus will be wide open to the eternally lovely blandishments of Purcell himself, the inimitable. But those who have ideas of their own about playing style had better stay away. They'll hail, or simmer, or merely be annoyed, at Mr. Mahler's musical blinders.

The four Suites, all derived, are from Purcell's stage works "Abdelazer," "The Married Beau," "The Gordian Knot Untied" and "The Virtuous Wife." In one you will hear the original theme for Benjamin Britten's "Young Person's Guide to the Orchestra".

Italian Music of the Renaissance. Choir and Soloists of the Polifonica Ambrosiana, Mons. Giuseppe Biella.

Vanguard BG 623 mono

This is perhaps the worst blooper of a disc of its type since the Italian monstrosities of early music that Vox brought out years ago—and recently reissued.

It is not merely that these Italians, like so many of their colleagues in the business sing the old music in super-Carmen style, like a drunken chorus from "Il Trovatore", out of a very provincial opera house! They have a right to their own conception of "Renaissance" style, even if it is indistinguishable from salami-opera. What really counts is that these performers sing outrageously out of tune, as well as with a slithering, vibrato-ridden lack of ensemble.

Style is one thing, plain musical accuracy is another. The first short unaccompanied item on this record flats virtually a whole tone in a couple of minutes. The succeeding numbers continue to sag dismally, as though the singers had never so much as heard a chord in proper tune. Few of their harmonies are.

Since my own choral group of American amateurs can sing this same sort of music for a half hour or so without pitch deviation, I'm in a position to snort with horror. I do so!

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

Vanguard VRS 9099 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 special Vanguard virtue is to walk this line straight down the middle—though some critics will push the company offside, according to their points of view. The outstanding Vanguard break-through in this fashion was with the fabulous Weavers, who made big-time all over the place. But others have followed along, including the now-famous Joan Baez (who leaves me cold as far as styling is concerned).

Darling is nearer the pure side of the line than some, but he'll go far. No double bass on this disc, which in these days is an indication of purity like the driven snow. But the peculiarly nasal, screaming, honking Darling drive, right out of the mountains via the big city, will carry anybody on to realms of pleasure, popular or otherwise. Banjo and Twelve-string guitar, too.

What is most pleasant about a Darling session like this is the gently accurate satire that emerges, within the highly individual Darling style. He doesn't actually take off his famous colleagues, from Lead Belly to Woody Guthrie and Blind Sonny Terry. They seem to peep roguishly over his shoulder as he sings, deadpan. A real master of style this boy.

The Greenbrier Boys.

Vanguard VRS 9104 mono

Here is Vanguard aiming ever so discreetly towards the big-time, on the heels of the Weavers. This one features a modest but unmistakeable double bass, 'way down on the bottom. On juke boxes it'll boom predictably. On home hi-fi systems it gets out of the way very nicely.

These three wry-faced city boys are aimin' for fame, but they stick fairly well to the authentic school of thought. One of them does the solos, in a suitably hill-billyish tone of voice; the others harmonize now and then and all of them play—banjo, mandolin, guitar—with extreme expertise. An old-fashioned fiddler joins in once in awhile. Probably another college kid.

Authentic or no, the main trouble with this disc (and its best juke box appeal) is a certain sameness and dullness. Most of the tunes are pretty sappy, though well dressed out in the playing and singing.

Shoshana Damari, Orch. conducted Elyakum Shapira.

Vanguard VSD 2103 stereo

Vanguard's Israeli department is a lively one. This fetching contralto sings a cross-section of current Israeli production with one of those new-style Israeli voices, combining the timeless Orient with remnants of the West, that have already endeared Israeli pops and folk music (the same thing, more or less) to world-wide listeners. She sings loudly and through her nose, a thin, brilliant tone color without vibrato, utterly unlike the cultured Western-trained voice, whether night club or opera style.

The music, still only half consolidated, already has a distinctive Israeli flavor as most listeners know, whether it be sheer oriental (to drums or lute sounds), or reminiscent of a central European cafe, vaguely Hungarian or Viennese or Russian, or even the most surprising Israeli style, a type of tune-and-harmony that distinctly sounds like the best Elizabethan English, ever so pure. All these varieties are here represented, in the somewhat raucously expressive Hebrew of Damari. Guitar, clarinets, (an-toms, a heterogeneous collection, are her accompaniment.

ODDITIES

The Definitive Piano—Famous Composers Play Their Own Music; Famous Pianists of the Past.

Telefunken TH 97009, 97013

Here is the famed Welte-Mignon player piano again, and some of the same piano "rolls" that Columbia transcribed on early LP more than ten years ago. Different modern piano, different recording, and the direct comparison of the numerous realizations that overlap in these recordings—Debussy played

by Debussy, for example—will make an absorbing study for those who still own the old Columbia restorations. They are the same, yet not the same. The difference helps us to understand the virtues 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 Mercury—no electronics in those days—for an individual thrust to each separate note. (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 mikes nearby to hear Debussy, Grieg, Saint-Saëns, Mahler, Busoni, 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 pedalling, the most difficult subtlety to reproduce, since the pianist's foot often "half-pedals", adjusting 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 recordings, is clearly not the same in respect to clarity of definition. The Telefunken 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.

Waltzes from Old Vienna. (Josef, Johann Strauss; Joseph Lanner.) Alexander Schneider, with string quartet.
Columbia MS 6316 stereo
(mono: ML5716)

This is a repeat performance, if I remember well, a batch of old waltzes 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 the main worker, too. He plays all the tunes.

In fact, I can't figure how the other distinguished musicians managed to avoid utter boredom—Felix Galimir, Walter Trampler, Paul Wolfe, and Julius Levine on the double bass (no cello). For hundreds of measures all any of them get to do is the last two thirds of the waltz oom-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 waltzes ending each side, the music is unfamiliar, the Lanner pieces sounding rather Schubertian, though he was called the "Mozart of dance music" according to Columbia's notes.

The Magic of the Bells.
Mercury SR 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 British, maybe out of an Indian temple or something. I didn't look closely enough at the label. All you get here is a lot of rather sanctimonious hymns, hommed out at ultra-close range—you can see the whites of the bell-ringer's eyeballs—on the Laura Spelman Rockefeller Memorial Carillon of the Riverside Church in New York.

The fi and the stereo are terrific. But the normal sound of these hymns is received from afar, down below, and so intended; this closeup is a tonal distortion equivalent to standing inside a brace of organ pipes during a full-organ peroration. Maybe the thing to do is to jack up your loudspeaker onto the roof and play hymns for the neighbors. 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 pipsqueak church steeples. Mercury may well clean up on this one.)

BIG COMPOSERS

Stravinsky Conducts Stravinsky—The Firebird (orig. version, complete ballet).
Columbia MS 6328 stereo
(mono: ML 5728)

Stravinsky Conducts Stravinsky—Petrouchka (1947 revision, complete ballet).
Columbia MS 6332 stereo
(mono: ML 5732)

Igor Stravinsky Conducts, 1961. (Movements for Piano and Orch., Double Canon; Epitaphium for Flute, Clarinet and Harp; Octet for Winds; L'Histoire du Soldat.)
Columbia MS 6272 stereo
(mono: ML 5672)
(All above with Columbia Symphony Orch.)

Columbia is canny—has been for a long time. Back in the Thirties the company issued 78's with Stravinsky conducting his own works—I still have some, including the first "Histoire du Soldat". Briefly outmaneuvered by RCA, Columbia bided its time and grabbed the composer back, though presumably RCA didn't appreciate his lack of sales on its Red Seal label. Now comes the pay-off: Stravinsky is at the top, and has just turned 80.

These three are only a few out of the prize repertory the Columbia label can sport of this over-prolific composer, who now makes

(Continued on page 58)

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 performance (see Fig. 1).

Included in the repertoire are nearly all of the recordings of Enrico Caruso, Jussi Bjoerling, John McCormack, Nellie Melba, Alma Gluck, Titta Ruffo, Maria Nemeth—in fact, many of the great opera recordings made in the past 50 years. Some are so rare that no more then twelve cuts are in existence.

The audience arrives to receive a warm welcome by the Horwitz family. They are escorted through a pine-panelled 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.

As 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 Mimi and Rudolpho's Paris in "La Boheme"; 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 long in advance. 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 980 arm and cartridge. Naturally the performances are "stereo." Æ

* *Another opera lover.*

Fig. 1. Closeup of the stage.

Fig. 2. Robert Horwitz (R) confers with the Teatro's Musical Consultant, Bob Meyer (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 Toscannini, who appears to be listening intently, and directing the opera in progress. Note the glass-enclosed turntable.

JAZZ and all that

CHARLES A. ROBERTSON

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 inspired by his watching changing tides on the East River. In celebration of the tenor-man's entry into the RCA Victor fold and return to performing in public, George Avakian sums up the whole story in the liner notes, with suitable references to the symbolic choice of the Williamsburg Bridge as a place to practice in complete freedom. While bouquets are tossed to the jazz reporters for covering the event accurately, no mention is made of those skeptics who expressed doubt that the announced sabbatical would last even a year. Rollins surprised quite a few observers of the jazz scene by keeping an unbroken silence for more than two years, in spite of spirited bidding from record companies and numerous invitations to appear in concert.

Also considered unworthy of notice are allegations that Rollins simply became miffed because of all the publicity bestowed on John Coltrane, Ornette Coleman, Eric Dolphy and the rest of the newer jazz abstractionists. As his efforts helped found this school of improvising, it seemed safe to assume some resentment on his part at the amount of attention being given late comers. He would emerge from hiding, according to one persistent rumor, as soon as he worked out something advanced enough to leave nearest rivals struggling in his wake. This theory gathered momentum after his pilgrimages to the pedestrian walkway on the bridge near his Grand Street home became known, and his first return engagement at a New York jazz club drew the curious in droves. Rollins again upset all the guesswork by proving conclusively that his reasons for taking a rest were exactly as claimed. Instead of plotting startling innovations, Rollins used the interval to consolidate his forces, reexamine earlier work, and in striving to attain stylistic perfection.

The big news about the quartet's first studio trip is the new mark Rollins sets as a player rather than any claim the group might make to being more "far 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 simply 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 more contemporary shape of Wall Street's skyscrapers, but the title piece clearly indicates where the decision went. Long, graceful choruses of 24 bars, plus stereo to help the imagination along, will enable even those listeners whose constitutions are not quite so hardy to ascend to the same vantage point, looking downstream at the Brooklyn Bridge. Far from being the first creative artist to succumb to the powerful attraction of a bridge, Rollins is one of a notable list which 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 studied and copied extensively.

That 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 position. Improved breath control was pursued through regular exercise all during the vacation period, resulting in accumulated dividends which pay off in this recording. Because of increased facility and greater command of his horn, complex ideas become lucid and are more easily accessible to the listener. Along with Miles Davis and numerous other modernists, Rollins emulates Louis Armstrong's passion for physical fitness, and the popular image of dissolute jazz musicians is no longer valid. The majority keep in better condition throughout the year than many baseball players do out of season.

Although Rollins does his thinking in the post-Parker idiom, he bridges the gap in tonal values to return to the standards set by such fully rounded masters as Coleman Hawkins and Don Byas. Just because Parker's ideas and techniques were amazing enough to be given priority is no reason for his followers to believe their own efforts can survive the handicap of unpleasant tone. Rollins is better equipped than ever to get a message across, and does so without straining his voice in the rude cateries 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 introduced, *God Bless The Child*, in which phrases are driven home with riveting-gun force or caressed with the tenderness of a lullaby. Ballads also are handled with a lighter touch than before, but the atelier approach is no less firm and compelling on *Without A Song*, *Where Are You*, and *You Do Something To Me*.

Even though the quartet is admirably fitted to bridge any of the various jazz streams, a search continues for the right drummer, as the two heard alternately on this recording are no longer members. If Rollins ever visits Los Angeles, he would do well to give Frank Butler a trial. And if RCA Victor wants to be adventurous, engineers might be detailed to set up stereo equipment and record the group after midnight on the bridge itself, before aspiring tenor players stake out claims to all the rehearsal space.

Oliver Nelson: Afro/American Sketches
Prestige Stereo 7225

Although the charge of faddism is often leveled against jazz fans, they are nowhere near as avid in pursuit of latest fashions as the record companies. A jazz label unable to offer an album with Africa in the title is out of the running these days, and so are some of the hurried productions already on the shelves. This latest arrival is admittedly designed to catch the trend, but the lesson in geography never interferes with jazz content. A little more than a year ago, Prestige approached Oliver Nelson with the idea and overcame some reluctance to accept the assignment by presenting him with about fifty LPs of tribal ceremonies and other ethnic material gathered on the spot. After four months of study, Nelson reached the same conclusion as jazz musicians who have traveled and worked recently in Africa. It was evident that European influences had penetrated into the most remote settlements, affecting nearly every musical activity except the traditional native drumming. Even the link between the rhythms of Africa and American jazz is more tenuous than most histories of jazz try to make out, which may explain the failure of some attempts to combine the two. By splitting the suite into seven episodes, Nelson lets each country carry the burden in turn, calling on his African sources mainly for contrast and to extend the usual big band framework.

One story going the rounds has Nelson lining up an extra man on each key instrument to make certain the orchestra would be fully staffed. Instead of waiting to be called, several spares appeared at the first session and were put to work with everyone else, swelling the ranks to twenty-one. The debit on Prestige's ledger is a big gain for purchasers of the stereo version, even though only seventeen men were hired for the two remaining sessions. Whether accidental or not, among the aural assets are a full section of french horns, and cellists and flutists in pairs. Only the two opening parts are devoted to Africa proper, but Ed Shaughnessy and Ray Barretto continue their drum conversations whenever necessary, with a rhythmic assist from bassist Art Davis. The influence of Quincy Jones turns up both in the writing and the choice of several regulars from his band, including Patti Bown, Melba Liston and Julius Watkins. Sharing solo honors with Joe Newman and Jerry Dodgion, the leader alternates on alto and tenor sax to prove once again that America can be proud of the blues.

If everyone who likes a touch of early Ellington, big bands, or unusual rhythm patterns buys the record, Nelson may get another chance to hire twenty musicians. He certainly deserves it, as this album is a real stereo treasure.

Eddie Condon: Chicago And All That Jazz!
Verve VSTC266 (4-track UST tape)

Few television shows ever had a happier sound than this reunion of Chicago stalwarts last winter, and the historic event is well worth preserving alongside Riverside's return to the city in the "Living Legends" series. As a good thirty-five years have gone by since the famed Okeh sessions, even the ears of television reviewers are attuned to the music and no one bothered to point out that McKenzie-Condon Chicagoans were the angry young men of the day. If Eddie Condon now becomes enraged at the modernists, it is usually because they are too genteel or overly intellectual. As for the angry young men of today, he has only himself to blame for first showing the way by mounting attacks on the dreariness of pop tunes and the bastions of Tin Pan Alley.

Jack Teagarden and Pee Wee Russell missed the Chicago sessions, only joining the gang after it moved to New York, which may explain why neither is known to get mad at anything or anybody. Teagarden's trombone playing would raze the Walls of Jericho without a drop of blood being shed, and his vocals are world-weary enough to quell all sounds of battle. Russell's most violent action is to test the thinness of thread on which a clarinet phrase can hang and not plunge to disaster. Together they have earned the right to be nominated for a joint award of the Nobel Prize for Peace.

The recording session took place way past midnight, after rehearsals but prior to the show, and everyone concerned enjoyed relaxing out of sight of the probing camera eye. The choruses are a little longer, spirits lighter, and the sound a whole lot better. The four-track stereo tape gives a good idea of what television audio should be like by 1977, but why wait? Four or five minutes of unused tape at reel end can be filled by copying *Nobody's Sweetheart Now*, *China Boy*, or another original version to complete the program. Bud Freeman, Bob Haggart, Jimmy McPartland, Gene Krupa, Joe Sullivan, Lil Armstrong and Blossom Seeley also put in an appearance, and Ray Hall is credited with handling the date.

Cannonball Adderley: In New York
Riverside Stereo RLP9404

Recent changes in Cannonball Adderley's personnel brought in two new members, swelling the ranks to sextet size and adding a distinct international flavor to the old quintet's sound. Always one to go direct to the source, the leader steps into the role of cosmopolite by placing the waltz division in the hands of Joe Zawinul, a pianist born thirty years ago in Vienna, where he began studies at the Conservatory at the age of seven. As

the jazz waltz did much to establish the group's popularity, requests for at least one must be answered during each set, and no new album would be complete without the inclusion of a freshly minted original. Zawinul will undoubtedly be called upon to meet future quotas 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-starred 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 *Dat Dere*. Zawinul prefers to show how thoroughly Americanized he has become, making an opening bid as composer with *Scotch And Water*, a plunging blues line which probably owes something to Dinah Washington. Since arriving in this country four years ago, Zawinul 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 Yusef 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 rubbing, he manages to cover a good deal of uncharted territory with just oboe on a work of his own named *Syn-anthesis*. 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 ST1681
Gerry Wiggins: Relax And Enjoy It
Contemporary Stereo S7595

The singer who refuses to heed her pianist's advice had better beware, as no keener 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. When they worry about success or making the top forty, he undoubtedly urges each one 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 living room. 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, muted trumpet in the background, and Ben Webster's tenor sax unfolds a lyric plaint on *Lover Man*. But Miss Starr's first concern seems to be pleasing the acute ear 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 unexpected turn of phrase and never allowing passages to become too florid. The group heard here gets together at odd intervals, when Nelson Riddle frees Joe Comfort from playing bass on studio jobs, and drummer Jackie Mills vacations after touring with Harry James. Wiggins carries with him a vocalist's preference for tasteful ballads, and the unexpected also turns up again in the choice of tunes. General laughter would be heard at any jazz club following a request for Ethelbert Nevin's *Narcissus*, but Wiggins indulges in this favorite of self-approving amateur 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 limp

along. Crediting Tatum as reigning influence, Wiggins keeps technical displays from obscuring the melody on *The Lady Is A Tramp*, and *My Heart Stood Still*. *Blue Wig*, the lone original included, manages to cover territory from Meade Lux Lewis to Thelonious Monk. Roy Du Nann'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 catalogue lists a certain item is no guarantee that the recorded effect will slip undetected into a given dramatic sequence. As sound in its purest form rarely fits human situations, this third volume of selections from Audio Fidelity's library consists mainly of sounds heard against a natural or realistic background. The siren of a passing police car mingles with other traffic noises and the close up click of pedestrian heels. A battery of teletype machines rattles away among all the other activity of a busy newspaper office. The agony of tortured metal emerges from an actual machine shop, and the various clock interludes include a visit to a cuckoo clock shop. The hiss of a welder's torch is preceded by the blast of an air hose and the heavy crunch of an acetylene cylinder being rolled across a concrete floor. Rainfall comes accompanied by thunder, city traffic, or the quiet rustle of trees and underbrush. The Aberdeen Proving Ground is the setting for pistol, rifle, machine gun and artillery fire, right down to the final impact of bullets striking the targets. New York provides several street scenes, not the least of which is a subway journey.

Among the forty-five different effects are a dozen or so examples of objects recorded without conflicting noise from other sources. But even these relatively pure sounds are subject to such acoustic variables as room condition, microphone placement, and the nature of the equipment used in processing 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 assorted timepieces would be a career in itself. Not even Sidney Frey is apt to carry authenticity quite that far, but the choice of subject matter he presents here is wide enough for any practical purpose. At least, the artificial devices used as often on radio are vastly improved upon. Outstanding are the clanging of blacksmith's hammer on anvil, a Model "T" Ford in action, a freight elevator and Navy alarm buzzer. The stereo effect in some cases is quite tricky, turning up as a fringe benefit from the background while the central sound remains stationary.

Franz Jackson: Jass, Jass, Jass
Philips Stereo PHS600-013
Franz Jackson: No Saints
Pinnacle PLP102

The personal activity of Franz Jackson as recording engineer in behalf of his Original Jass All Stars is finally paying off on other labels besides his own. In addition to appearing on the initial list of Philips releases in this country, the band will be represented shortly by an entire LP in Riverside's "Living Legends" series. A change of affiliates brought about the introduction of the Philips label over here, and Mercury will receive wider distribution all over the world in return. Mercury recorded the All Stars set about three years ago, but apparently only a full-scale merger could tear it loose. Playing in a studio puts the band on its best behavior, and the general exuberance is below the level reached on Jackson's recording at the Red Arrow Inn. Several high points are marked though, and the band races along at flood tide on *Cornet Chop Suey*, *High Society*, and *Washington And Lee Swing*. Especially worthy of note is Jackson's *Don't Forget The Blues*, a tribute to Big Bill Broonzy. Bernie Clapper of Universal Recording handled the date, and stereo brings out the extreme contrast between Bill Oldham's tuba and Lawrence Dixon's banjo.

The first All Stars LP is still the best by a slight margin, and it becomes available once more with the transfer of the original Replica release to Jackson's privately owned Pinnacle label. The clarinetist received electronics training during World War II, and the experience came in handy when he recorded Bob Shoffner's trumpet solo on *Sugar Foot Stomp*, and Al Wynn playing trombone on *Al's Strut*. Stereo or not, traditionalist fans will find nothing to complain about in the sound.

Turk Murphy: Let The Good Times Roll
RCA Victor LSP2501

While revivalists no longer make a big noise in print, this musical blast from San Francisco is loud enough to keep the movement from dying out for some time to come. The reason for the extra decibels is a genuine calliope, brought live and kicking into the studio to roar regally on *Tiger Rag*. Described as a portable member of the species, the beast weighs a mere 800 pounds and can be transported by a smaller vehicle than steamboat or circus wagon. As it eats compressed air instead of steam, the engineers had to contend with an explosive drive motor. Anything they fail to screen out in the background remains to be covered up by extra forceful playing from Turk Murphy's hearty crew. Having tamed the calliope to this extent, engineers Al Schmitt and Dick Gardner proceed to prod it into stereo action, imparting enough motion to place it once more atop a riverboat coming around the bend on *Paddle-Wheelin' Along*. Pete Clute, pianist in the sextet, also takes charge of the added attraction, and Bob Short echoes each roar with an answering bellow on tuba. Clarinetist Bob Helm switches to soprano sax to join in on *Bilbao Song*, in a new arrangement which gives the Kurt Weill tune the same happy beat Louis Armstrong received from Murphy to make a bestseller of *Mack The Knife*.

Lest the calliope's welcome be worn out, Murphy puts the novelty instrument away after three numbers and gets down to the serious revivalist business of swapping away the cobwebs on *Terrible Blues*, *Struttin' With Some Barbecue*, and *Wild Man Blues*. Sharing honors with the trombonist is Ernie Carson, a cornetist who knows all the traditional breaks and a few new ones of his own. To complete the picture of the band on home grounds at Earthquake McGoon's in the Bay City,

vocalist Pat Yankee comes to the fore and applies her special brand of volcanic flexion to *Big Butter And Egg Man*, and *Lonesome Road*. But the unbilled star of the show is the calliope, 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 1890 Indian head nickels on the cover of this album would either start a substantial bank account or buy a term in Federal penitentiary for counterfeiting. A plain ordinary nickel, however, is still legal tender at Gay Nineties Village, a tourist attraction in Sikeston, 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 pets. 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 struck the competing jukebox industry several years ago.

Historically speaking, the nickelodeon stands 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 popularity of traveling minstrel shows is reflected by the Encore Banjo, which was patented in 1893. Equipped with picks actuated by pneumatics capable of ten strokes per second, the banjo plays four strings for a total of 44 notes. The Wurlitzer Fascinator, an orchestra piano, boasts 88 violin and 38 flute pipes. The Eakins Special, assembled by the proprietor from four different machines, contains a 61-note organ manual. The Memory Lane and the Red K. T. Specials both include mandolin and xylophone attachments. All feature percussion of various sorts and sizes, and tempos are brisk and lively on such turn-of-the-century tunes as *King Cotton*, *Georgia Camp Meeting*, and *Over The Waves*. Concealing the mechanics involved never entered the engineer's mind, and the preparatory creaks and groans are all recorded in broad stereo before the action gets underway.

Jo Stafford: American Folk Songs
Capitol Stereo ST1653
Burl Ives: Songs Of The West
Decca Stereo DL74179

Since folk singing is now big business, quite a few pop singers take an occasional flier in the field, thereby setting an example that can be followed in reverse just as easily. Jo Stafford is no recent convert, having made forays in this direction before during frequent ventures outside her usual category. A singer who refuses to be pigeonholed, she brings a bright and cheerful air to any musical branch on which she happens to be perched at the moment. Her intentions seem to be entirely friendly this time, and rival lady songsters need not become alarmed to the point of flying deeper into the woods. Instead, they had better listen and learn assurance, or a few new tricks, when Miss Stafford fills the surrounding countryside with news of *Barbara Allen*, *Old Joe Clark*, and *The Nightingale*. Husband Paul Weston falls quite naturally into the role of admiring male on the ballads, conducting a choir of strings and woodwinds in the background. The livelier tunes are accented by the banjo plucking of Joe Maphis.

Burl Ives began bringing folk music to the people so long ago that about the only challenge left is to try beating teenage idols at their own game. Not only does he stay abreast of popular styles, but he often turns his knowledge of songs and audiences to creating new trends all by himself. Whenever this veteran places among the top forty with songs like *A Little Bitty Tear*, the victory is some consolation for all the gloominess now prevalent in folk music. Competitors will find nothing friendly in his approach to western songs, as he outdraws the Hollywood and television brand of cowpoke every time on *When The Bloom Is On The Sage*, *Cool Water*, and *Memorial Rose*. Stereo keeps the soothing choral group at a respectful distance. JG

ABOUT MUSIC

Harold Lawrence

THE ART OF SPLICE HUNTING

ROUGHLY 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 Cinerama 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 anachronisms 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, leafing through pages of 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 boners as "Soup du Jur." And he reads the letters to the tabloid editors to revel in syntax-distortion and howling hyperboles.

At the dial of his FM radio, the musical fault-finder lies in wait for the gauche announcer who stumbles through the names of composers and musical compositions and occasionally comes up with such gems as ". . . the opera, "Jewels of the Madonna," by *Enamel* 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 Weinstein?

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 is 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 *tutti* 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 over-all 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 Brahm's "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-barometer 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!" AE

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AUDIO ETC

(from page 14)

earphones. At first thought, one would expect that since the signal in one channel is also appearing at the other ear, identically and almost as loud (90 per cent), the lady should appear in a mono image, straight ahead; but since the out-of-phase signals also appear in identical duplicate at each ear, she should have a second and overlapping echo-image on top of the first—but because the original out-of-phase signals *also* are heard by the two ears and fused, she should have a third image off in left field, where Channel One originated!

Obviously, this line of thinking is spurious. It just doesn't happen that way. If the gal sang to the left in the stereo recording, she'll be altogether on the left in the phones, even with 90 per cent overlapping blend of the stereo channels. That will be the observed fate.

You will learn a lot about this problem by reading the original Bauer paper in the *Journal of the AES*, Oct. 1961. It describes very neatly the differences between basic stereo loudspeaker and earphone listening with excellent diagrams.

Unfused Transients

I think it is worth adding, finally, that most of the confused one-ear sounds in stereo via phones are not the primary or "fundamental" sounds but in large measure the incidental reverberant tones which place the music in a spatial context. These sounds are fleeting transients. They flit and come and go, almost instantaneously. But though you can't isolate them, the ears hear them one-eared just the same, and the mind tires just as quickly. Thus it is mainly the room-sound that tires you when most stereo is heard unblended via earphones; the "main" sounds are usually pretty well fused, with signals in both phones which the ears can grasp and cohere in space.

This one-eared effect is analagous to a stereoscopic picture in which the foreground blends in perfect perspective, but the background is different and for each eye and hence unblendable.

Only the extreme sort of stereo recording presents a foreground one-ear sound that won't blend in the phones but appears "inside" a single ear, most objectionably. This effect is all too common in popular records, which abound in one-sided stereo sounds. Classical discs and tape also have it in concerto-style records with close-up solos in one channel and in numerous vocal records with the same sort of one-sided solo work. The blending process is particularly essential for all such stereo records heard on phones.

To sum up: I do *not* recommend ear phone stereo listening straight from the record or tape, unblended. Only a very few recordings will be OK; the rest are sure to be variably distressing to the ears.

On the other hand, I do heartily recommend phone listening provided there is at least some blending available. The preference, musically, is for a large blend, the Ninety Per cent principle.

Most hi-fi amplifiers and control units have an adequate blend control, either continuous or by steps. If you don't have a blend control and want earphones, the earphone makers should provide you with a blend circuit as an accessory to their phones. Alas, few of them do at this point. Not many manufacturers have taken the time to realize the necessity of this blending for stereo listening. Yes—it might hurt immediate sales to admit it. But the long range market is going to suffer even more

if in a short-sighted way these very real problems in earphones listening are simply abolished by pretending they don't exist.

P.S. It'll have to be next month for my specific look at a batch of additional phones, and I ask the makers' indulgence, those who have already been so cooperative in sending me samples of their wares, often in two or three versions. I must say right now, however, that on the basis of this larger batch of phones I am more than optimistic about the quality of sound that you can now buy in phone form. It's terrific. AE

LIGHT LISTENING

(from page 50)

the head of the chorus. Of these two stereo albums, the Capitol disc presents more challenge than does the Bing Crosby tape. Some listeners will stick with the wearing quality of the tape for repeated playback under conditions of conviviality (records have been known to receive not-too-somber treatment at some singing parties) but the disc will appeal to any group that has outgrown the usual sing-along album and now wishes to tackle something trickier.

Capitol has assigned Arthur Godfrey to the lead off position in a collection of sounds arranged by Richard Wolfe. In most of these tunes, Arthur sings the first chorus by himself. When he reaches the second chorus, a group of girls' voices enters with the words of the first chorus. A male group joins Godfrey and the girls on the third chorus. Old-fashioned rounds, with their multiple layers of lyrics striking the ear simultaneously, are a natural for stereo and producer Andy Wiswell has taken full advantage of it. Godfrey kids around at his own mike on the far left while the two groups share adjacent mikes at the right. The repertory is more international than most since it includes *Si Canzone* and the French favorites *Alouette* and *Frère Jacques*. The Godfrey drawl wrapped around a French lyric is really something to hear. Detailed instructions in the printed lyrics give the home singer ample opportunity to make a propitious entry with the group of his or her choice.

The Crosby tape makes up in quantity what it may lack in novelty. The latest production for Warner Bros. from Project Records assumes that the purchaser of this tape prefers not to dawdle when he takes on a collection of tunes. Each side of this reel embraces twenty-five songs in rapid succession. The Jack Halloran Chorus backs Bing in a lineup that leans heavily toward the old-time favorites.

Count Basie: The Greatest
Verve VST4-204

Lionel Hampton: Soft Vibes—Soaring Strings
Columbia CQ-424

In these tapes we find two great stars of the swing era acknowledging the changes that have overtaken the band business. The 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 enough to keep fresh the Hampton and Basie names with the tape buying public. The Count's band never gets a chance to really cut loose because the spotlight throughout the reel is on vocalist Joe Williams. There are fresh ideas in this collection of standards but they're all devoted to accompanying the vocalist.

In his smooth-sounding Columbia reel, Hamp has a row to hoe that's a bit stickier than Basie'n because he has to adjust his style to complement a group of strings. The apex of lushness is reached in the treatment of *Deep Purple*; rhythm-and-blues predominate in the handling of *Do Nothing Till You Hear From Me*. The old inventive Hampton touch has its best moments in the beguine tempo of *Once in a While*. AB

NEW PRODUCTS

• Transistorized Integrated Stereo System. Designated as the "Astro," the new Altec-Lansing Model 708A is a complete stereo tuner-amplifier system packaged on a single chassis and employs transistor circuits. The Astro contains mono AM and FM tuners, FM-multiplex stereo, dual amps, plus a comprehensive control center. The entire system is housed in a cabinet measuring only 6 x 15 x 13½ inches. The Astro provides a total of 35 watts of

power and its frequency response is within 1 db from 20 cps to 20,000 cps. Distortion is less than one per cent (THD) at 26 watts. Stereo separation during FM reception is 30 db over the entire audio spectrum. Features incorporated in the Astro are: a headphone receptacle on the rear panel; index locks on both the balance and tone controls; built-in tape-monitoring circuitry; and a monitor light behind the station indicator panel which glows when a multiplex stereo signal is received. Key to the performance and compactness of the Astro is use of solid-state devices in critical areas and frame grid tubes for precision. The power stages are transistorized. Altec-Lansing Corp., Anaheim, California. **P-1**

• Distortion Meter and Audio Oscillator. The new Barker and Williamson Model 410 distortion meter measures audio distortion, noise level, and a.c. voltages and is also a versatile VTVM. Distortion levels can be measured on fundamental frequencies from 20 cps to 20,000 cps and harmonics are indicated up to 100,000 cps. Distortion measurements can be made on signal levels of 0.1 volt to 30 volts rms. The VTVM provides an accuracy of plus or minus five per cent over a frequency range from 20 cps to 200,000 cps. For noise and db measurements the instrument is calibrated in one db steps from 0 db to minus 15 db. The built-in attenuator provides ad-

ditional ranges from minus 40 db to plus 50 db in 10-db steps. The B and W Model 210 audio oscillator provides a sine wave signal from 10 cps to 100,000 cps. The output level is within plus or minus one db when working into 600 ohms (reference 5000 cps). Power output is variable to above 150 mw. Hum and noise is minus 70 db at 5 volt output and distortion is less than 0.2 per cent at 5 volt output from 50 cps to 20,000 cps, and slightly higher at higher outputs and frequencies. Barker & Williamson, Bristol, Pa. **P-2**

• Stereo Tape System. Containing complete electronics and built-in monitor speakers necessary for recording and playback of 4-track stereo and mono tapes, the new Sony Model 464-CS was introduced by Superscope to meet the demand for a low cost, portable, stereo recording and playback tape system. The Model 464-CS utilizes the Sony belt-free idler-wheel drive mechanism and dynamically balanced capstan fly-wheel assembly for maintaining extremely low flutter and wow specifications (less than 0.2 per cent at 7½ ips). Features include: pushbutton selection of Channel 1 or 2, or both; separate volume

controls for each channel, master volume control for playback; playback tone control; built-in sound-on-sound recording facilities; two high-level line inputs for recording FM stereo; stereo line outputs for connecting external amplifiers; and auxiliary speaker outputs. The Sony 464-CS comes equipped with two dynamic Sony F-7 microphones. The price is $299.50 complete. Superscope, Inc., Sun Valley, Calif. **P-3**

• Tuner-Amplifier. H. H. Scott, Inc. announces the Model 340 tuner-amplifier 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 whether 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 17½-in. wide, by 6½-in. high, by 16¾-in. deep. Price, east of the Rockies, is $379.95. H. H. Scott, Inc., Maynard, Mass. **P-4**

• 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 Scandinavian design 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 72½-in. long, 33½-in. high, and 16-in. deep. The speaker compartment is 25⅜ x 16⅜. The Model 303 sells for $89.50 and is shipped knocked down. It weighs 85 pounds. Audio Originals, Indianapolis, Indiana. **P-5**

• Multiplex Adapter. Dynaco, Inc. has recently introduced a multiplex adapter, designed to complement the FM-1 Dynatuner, called the FMX-3 Multiplex Integrator. This unit fits all Dynatuners and is wholly contained on 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 30 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 matrixing nor balancing, and precise alignment is a matter of a few minutes time for the home constructor using the "Stereobeam" as an alignment indicator. The FMX-3 kit (a 3-hour project) costs just $29.95 and the complete multiplex tuner, factory assembled and tested, is available for $149.95. Dynaco, Inc., Philadelphia 4, Pa. **P-6**

• Stereo Preamplifier. Featuring a new type of "rocker control" the MacIntosh 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 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. Tuner, tape unit, auxiliary signal source, and tape monitor inputs have an impedance of 250,000 ohms and a sensitivity of 0.25 volts, accepting signals up to 10 volts (30 for tape monitor). The phono 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 main output is 2.5 volts with rated input. The tape output is 0.25 volts with rated input. Controls include an 8-position input selector, a 7-position mode selector, bass and treble controls (for each channel) which have 11 switch points, stereo balance control, and a master volume control. Finish of the Model C-11 is gold and charcoal. It may be installed in

conventional, consoles, in custom-built installations, and in professional relay racks. It measures 12¾-in. wide, 5⅛-in. high, and 12-in. deep. The Model L66 cabinet is available for table-top installation. Weight of the C-11 is 15 lb. Price for the chassis only is $199.50. MacIntosh Laboratories, Binghamton, N. Y. F-7

• **Bookshelf Speaker System.** Only 8-in. deep, the new Utah "Sorcerer" Model SH4-W is a 5-way bookshelf system which fits into almost every living room in size and style. Basically a bass-reflex type of cabinet with a tuned port, the system contains an 8-in. woofer and a 3½-in. tweeter, with a crossover network. Thinner than most rows of books, it can be used on shelves, mantels, tables, or even hung on

walls. Keyhole slots in the back cover permit hanging in either a vertical or horizontal position. The walnut-veneer surfaces and the solid-walnut trim have a low-gloss oiled finish in keeping with today's furniture trends. An unfinished hardwood version, suitable for staining to match other finishes, is the Model SH4-U. The system will handle 12 watts of audio power. Over-all size is 12 x 20 x 5 in. Price of the SH4-W is $49.95 and the SH4-U is $46.95. Utah Electronics Corp., Huntington, Ind. F-8

• **Fairchild Compressor.** A compact compressor recently announced by Fairchild Recording, the Model 663, represents a new approach in level control plus use of miniaturized circuitry. The unit is no longer than a slide-type attenuator (1⅝" x 7" x 4"). The unique size of the device allows the installation of a level control on every microphone channel for a greater degree of level control, which will permit the

production of more dramatic program effects. The 663 has an attack time of 40 milliseconds and a variable release time from 300 milliseconds to 7 seconds. A zero-gain device, the 663 can compress up to 20 db without an increase in distortion and is designed to work into low-impedance circuits. Metering is provided along with a variable threshold control and variable release time control. Fairchild Recording L.I.C., N.Y. F-9

AUDIO Teasers

AUDIO will pay $5 for questions or answers used. Send questions or answers to: Audio Teasers, P. O. Box 629, Mineola, N. Y.

NORMAN H. CROWHURST

Answers to Last Month's Teasers

Answer D-1. Actually this is a fairly common effect (or defect) in amplifiers. What gets overlooked in the design is the fact that there is a mode in which an amplifier with push-pull output can function as a single-ended circuit on *transients*. It works like this:

When level changes—as it is doing all the time in musical program, but not under test conditions—the operating point of the output tubes changes, resulting in a change in the B+ current demand. Because of the B+ supply impedance, the change in current produces a change in voltage. This gets fed back to the input stage plate circuit, and can be amplified by the second stage as if it were a low-frequency audio component.

The decoupling elements and interstage couplings all act as time constants in a feedback loop that operates essentially single-ended for this component. In a bad case, such an amplifier can be kicked into a "hunting" oscillation, which will produce no audible output itself, because the output stage is push-pull and the signal "cancels" at this point, but it modulates all signal passing through the amplifier. In the case that forms the basis for this question, the amplifier is basically quite stable, but the transient levels of program excite a periodic fluctuation of the same kind, that will die out whenever the transients are not there.

A meter on the supply circuit will show quite clearly what is happening in a case like this.

Answer D-2. That tone control circuit will produce its maximum bass and treble boosts under the purely hypothetical condition of working from a zero source impedance into an open circuit. In practical circuits, the source impedance is that of the previous stage, while the load impedance is the grid resistor of the following stage.

If the source impedance of the previous stage is made higher, by using a tube with higher plate resistance and/or coupling resistor, the treble boost is limited. Although the source resistance is in series "at the top," it forms part of the total voltage divider that is *not* bypassed with the boosting capacitor and therefore adds to the *effective* value of the bottom resistor, for boost purposes.

If the load impedance provided by the following grid resistor is made lower, it will limit the bass boost. The full bass boost is only achieved by open circuit. Even the potentiometer used to vary from boost to cut at the bass end "loads" the maximum bass boost. The grid resistor provides additional loading. Using a lower value of grid resistor reduces the bass boost.

The difference observed in the question occurred because the amplifiers employed stages with different values of plate resistance and the following stage grid resistors.

Answer D-3. This question is responsible for many letters from readers, from time to time. It most often takes the form, "How can a high-pass filter produce a phase advance?—How can the signal come out at the output, before it goes in at the input?" That's a good question!

When asked that way, of course, it is obvious that a circuit cannot *anticipate* a signal yet to arrive. The phase-advance analysis is based on steady-state tones. In terms of steady-state signals, a high-pass circuit definitely does produce a phase advance. One reactance element produces an ultimate of 90 deg., two reactances produce an ultimate of 180 deg., three reactances 270 deg., and so on. Also the advance is progressively a greater angle (up to this ultimate) with lower frequency (greater attenuation).

Admittedly, at any one frequency, when talking about steady state, a phase advance of, say, 60 deg. could equally well be identified as a phase delay of 300 deg.—it is merely a matter of angular relation. But this is not realistic, because its logical extension through different frequencies leads to a phase displacement of some complete number of phase rotations (360 deg.) in the pass range, when in fact the filter has virtually no effect at these frequencies.

For steady-state analysis, a high-pass filter has a phase advance, then. But this does not enable it to anticipate that someone is going to apply a signal of x cycles, half a cycle hence, so it can start giving output now. A high-pass filter is simply—in its basic form—an inversion of the low-pass configuration, taking the output from "the other element." Just as a low-pass filter exhibits a delay, in build-up as well as steady state—but not necessarily both the same—the high-pass has the same build-up delay as its corresponding low-pass, but a corresponding steady-state advance. AE

ALIGNING ADAPTERS

(from page 28)

it was a simple matter to provide this 19-kc 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.

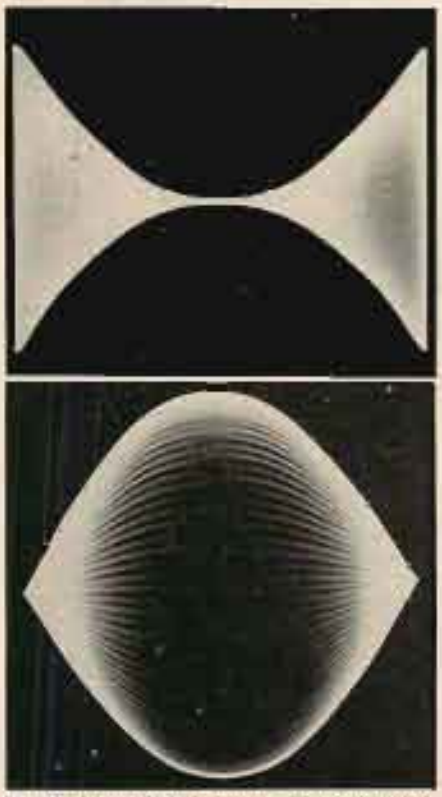

Fig. 9, (upper). Left input signal; (lower), right input signal.

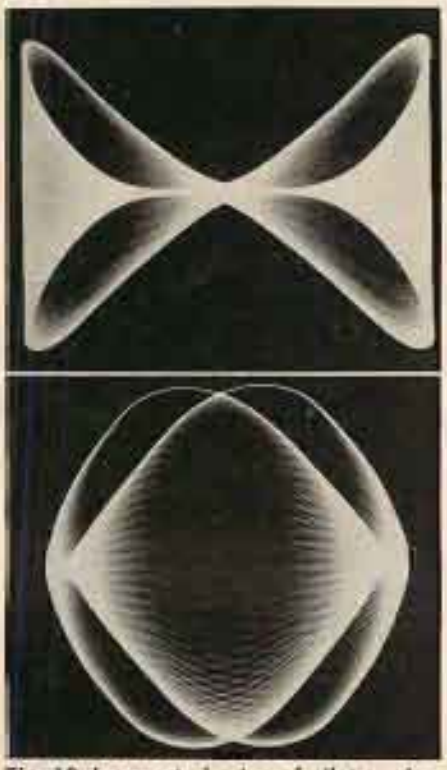

Fig. 10. Incorrect phasing of pilot carrier.

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 kc with only 1 per cent harmonic distortion. The distortion actually measured for a ±75-kc 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-

age, in fact this ratio may vary as much as 100 per cent. Thus the peak deviation of an FM generator modulated by a signal as illustrated in (D), (E), and (F) of *Fig.* 8 is the same for all three modes of modulation, but the rms values of the signals are all different.

Normally this type of meter uses a d.c. amplifier which implies the necessity of including an electrical zero adjustment. By using a power pentode as meter driving-stage this inconvenience is avoided. Æ

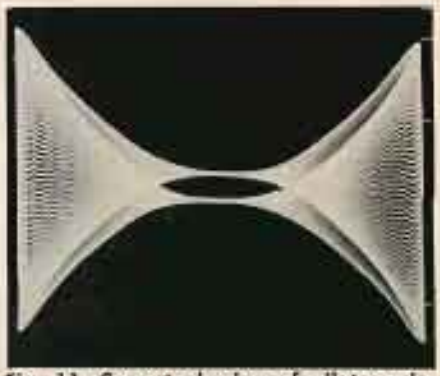

Fig. 11. Correct phasing of pilot carrier but pilot carrier in composite output signal not suppressed.

EQUIPMENT PROFILE

(*from page 55*)

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-HOLD" 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 or announcements—it is more convenient to set the switch at the HOLD position; otherwise the motor would run the switch down to the .003-volt range at each interval. With the high impedance of the instrument, open-circuited leads or even the shielded cable furnished leads connected to the input will pick up sufficient voltage from hum fields to indicate somewhere in the vicinity of 15 volts when used on a typical test bench. Clip the leads together, and the motor immediately runs the switch down to the .003-volt position and stops. If one is measuring a number of voltages on the same range with the switch in the HOLD position and then 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 3/32 in. apart, which makes for easy readibility. The input and output terminals are of the standard laboratory type with ¾-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. F-25

INNER-GROOVE DISTORTION

(*from page 54*)

tance and offset angle. Returning to *Fig.* 1 it can be seen that between 3.5 in. and 3.75 in. the tracking error of arm "A" becomes higher than that of arm "B." This means that the error of arm "A" is higher for approximately the last 2/5 of the record. In addition, using 3.14 as *pi*, the circumference at the 5.75-in. radius is 36.1 in. and the circumference at the 2.25-in. radius is 14.1 in. Thus the outside groove is 2.56 times as long as the inside groove. Conversely, a given length of groove at the 2.25-in. radius contains 2.56 times as much information as the same length of groove at the 5.75-in. radius. This situation is aggravated by the fact that many musical selections end more loudly than they begin. These more heavily modulated inner grooves are naturally more prone to tracking error distortion. Furthermore, the importance of "skating force" diminishes

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 "B" is the better choice for the reproduction of modern stereo records.

APPENDIX 1

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 there. An early method of combatting 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 humps 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 11 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

(from page 56)

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 reeling motor, are mounted the transistor relay, K_3, and relay K_4. 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_5, 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 mode.

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 reeling and threading operation.

Another variation would be to install a second photocell setup at the right side of the mechanism, or logic circuitry with the present device, to automatically place the playback mode back 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

to effectively place the latching relay back into the forward mode. Momentarily switching S_{1A} to the STOP position and back to the RUN position would accomplish this. The operation, when switching to the opposite mode, requires a gradual slowing down and change in direction so that no loops or tape stretch would result to even ½-mil tape. Æ

RECORD REVUE

(from page 48)

reasonable sense to plenty of people who like their fi and their culture in a package. He's a grand old man, still baffling the categorizers, still turning out new things in new ways, mostly unexpected. Columbia takes them all in stride.

The two most recent releases, celebrating the 80th anniversary, are definitive Stravinsky performances of his two most popular ballet scores. "Firebird" is done here in the ultra-lush original scoring, which Stravinsky says is wasteful, though he likes some of his youthful orchestral tricks in it. The playing isn't at all Stokowski-like and, indeed, the seldom-heard and numerous passages of connective tissue that join up the more formal dance-sections 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 forceful version available. Stravinsky remains a medium-power conductor, and no more.

"Petrouchka" is in the leaner, more precise revised 1947 orchestration, which Stravinsky feels is no longer "amateurish"—like the original! A matter-of-fact opinion on his part, entirely realistic from his own high-level viewpoint. It's more of a continuous spectacle, this complete ballet score, though the fragmentary connecting passages still are a part of its style.

The 1961 "omnibus" record isn't as complex as it looks in print; a number of the works are very short. The jaunty "Histoire du Soldat" suite takes up one whole side; the similarly jazzy, Octet, a favorite of mine, is one major work on the reverse, the other being the recent "Movements" 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 Orch., 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 tunes, sung by a woman's chorus and occasional soprano solo, set in a raucously effective sort of dissonance—1917-style—that will titillate any ear tuned for hi fi. Marvelous orchestral effects, including the nearest thing to old-style jazz you'll find in Bartok, via a nose-thumbing trombone in the third piece.

These are masterpieces of folk music. To this day, Bartok is the only top-rank composer to have found a dissonant idiom that "fits" as a setting for folk idiom without distorting the folk-style musical values. Aaron Copland is perhaps a second master with his American tone-setting in such works as "Rodeo," "El Salon Mexico," "Billy the Kid," but his dissonance is mild and gentle alongside Bartok's far more sophisticated sort.

The difficult "Music for Strings, Percussion and Celesta" is played with quite remarkable understanding by this nominally "iron curtain" ensemble. Bartok's "Western" dissonance does not seem to have kept the Hungarians from turning to him in recent years as virtually the national musical hero. Recordings is excellent, too, produced by an apparently all-Hungarian team under Westminster's auspices. Æ

TRANSISTOR POWER SUPPLY

(from page 29)

When the system is first switched on it will go to this position because the capacitor connected to the base of Q_{10} will delay the flow of base current until Q_{12} has run off and seized control.

Now we start to move the cathode potential of the diode D_{11} 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_{12}. The emitters of both Q_{12} and Q_{13} start to move negative so that the current through Q_{13} begins to drop. This is enough to produce regenerative action through the resistance coupling the collector of Q_{13} to the base of Q_{12}, and the circuit switches to a state in which Q_{12} is on and Q_{13} is off. The current when Q_{12} is bottomed can be some 2½ ma, compared with about 0.6 ma when Q_{12} is bottomed. The result is that the emitter of Q_{12} goes negative and drives Q_{14} hard.

When Q_{14} bottoms it clamps the base of Q_5 in the regulator circuit down to the zero voltage line and, just to be sure, pulls the bases of $Q_{5,6,7,8}$ 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 dissipation is low. The energy stored in the filter choke can cause a voltage rise of about 5 volts at the collectors of the regulator transistors and this must be remembered when choosing the type to be used. It would be imprudent in equipment of this kind to go to the lowest possible working voltage and I should think twice before using, for example, the CTP1552 which has a V_{ceo} (SUS) of 20 volts at $I_b = o$, $I_c = 1.5$ amp instead of the CTP1544, which stands 30 volts under the same conditions for only a small increase in price. The 2N1147 which is actually used is rated at 25 volts under these conditions and this means that there is a safety margin of at least 5 volts. It will be obvious that by altering the resistance of P_{11} we can alter the current at which this switching action takes place. R_{11} is chosen to make the system switch at about 35 amps when P_{11} is set to zero: this is to protect the power unit. We then set P_{11} to switch the system at just a little more than the equipment which we are supplying should take and we will automatically protect this. The switching time is of the order of a millisecond so that it can catch thermal runaway almost before it takes off.

An important point in the use of any protective system is the resetting. We must be able to get the system operating again after a shut-down, but we must not be able to hold it on if we still have overload conditions. The capacitor connected from collector to base of Q_{13} through a pushbutton acts as a reset control. When we press the button we can consider the capacitor as an instantaneous short circuit, lifting the base up to the collector. This makes Q_{13} conduct and thus, by regenerative action, cuts Q_{12} right down and holds Q_{13} in bottoming. The resistance in parallel with this capacitance is too high to hold Q_{12} on but is there just to leak away the charge on the capacitor so that if Q_{12} is being held on by excessive current, the circuit takes a quick look at this and shuts off again. We must wait a few seconds before we can try to restart the system.

My impression is that this system is completely safe. It was set up with an automatic short-circuit system which put 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 at 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_1 down to zero level if the system 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 do understand and, after you have paid your taxes, *buy* a power unit. Æ

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The Tape Guide

HERMAN BURSTEIN

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. 3 and the right 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 level 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 is 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 in the absence 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 of 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 all 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 tapes to place them near an 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 return with just enough strength to become barely audible.

Monitor Phones Impedance

*Q. I own a **** preamplifier, **** power amplifier, and **** tape recorder, as well as a tuner and turntable. 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 circuit and causing excessive distortion and signal loss. Thus if you wish to obtain the signal at the point in your preamp 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 "Toccatas for Organ," Sonotape SWBS004? This tape was released in 1956 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 reissued on four-tracks.

A. I am hopeful that a reader of this column may come to your aid 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, Hewlitt, N. Y. You might also query United Stereo Tapes, 88 Llewellyn Avenue, Bloomfield, New Jersey. JE

NEW LITERATURE

• **Hi-Fi & PA Catalogues.** University Loudspeakers has just announced the availability of two new catalogues: one covering the company's high-fidelity products and one covering their public address products. The high fidelity products catalogue entitled "Your Guide to Component Stereo High Fidelity" is a 20-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 components to consoles 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, trumpets, 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. **F-11**

• **Stereo-Hi-Fi Brochure.** A 2-color brochure which allows easier reading because of its hold open format, Altec's 1962-63 stereo high-fidelity brochure, AL-1302-2, details its high-fidelity products ranging 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. **F-12**

• **Condensed Tube Catalogue.** Amperex Electronic Corp. announces a new 32-page condensed tube catalogue intended to serve as a quick reference guide for designers of new equipment as well as for replacement tubes. 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 on company stationery to Amperex Electronic Corp., Adv. Dept., 230 Duffy Ave., Hicksville, L. I., N. Y.

• **Auditorium 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 provides 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, Meadow Lands, Pa. **F-13**

• **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 figurations, and vacuum tube counterparts; a transistor radio and mercury battery interchangeability guide; charts showing direct interchangeability between American and British tubes; the latest Greek alphabet designations; information on db gain and loss and attenuator network formulas. All reference material of earlier editions has been retained including: log and trig tables; EIA and military color codes; fundamental algebraic formulas; most used electronic formulas and abbreviations, plus other essential information. The handbook contains 96 pages and is priced at 35¢ postpaid in the USA and is available from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Illinois. Ask for the Electronics Data Handbook (Catalogue #37K391).

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SALE ITEMS — bulk tapes — component quotes. Bayla, Box 131-0, Wantagh, N. Y.

PROFESSIONAL PRESTO 8N console disc recorder, amplifiers, cutting heads, automatic equalizer. Good condition. Trade for Ampex 354 or 351, 93 2-track stereo Concertone, or Presto tape recorder. John Price, 11619 Lippitt, Dallas, Texas.

WANTED: Olson cutterheads, 2 Presto 8D or 8DG disc recorders. Sound Studies, 230 N. Michigan, Chicago, Ill.

MAN, LONG EXPERIENCED hi fi installations and administration looking for appropriate position, New York City area. Box CF-1, Audio, P. O. Box 629, Mineola, N. Y.

SELL: Two Altec Lansing condenser microphone systems (21B), new condition $100 each. Matched pair, excellent for stereo recording. V. R. Hein, 418 Gregory, Rockford, Ill.

WANTED: Fisher AM-80 AM tuner or 80-R AM-FM tuner. Harry Pearson, 202 Jamesville Road, Dewitt 14, N. Y.

MARANTZ 1C audio consolette with cabinet $168 value, perfect condition $40. Fairchild 411 3-speed belt-driven turntable, hysteresis motor, mahogany base $169 value, perfect condition $25. John Hieb, 4118 Lincoln Place Drive, Des Moines, Iowa.

MUST SELL MY ENTIRE AUDIO SYSTEM. Klipsch type 3-way horn $225; lovingly made Patrician-type bass horn $225; Electro-Voice MT-30 mid-range horns $25 each; 4 4401 tweeters $11 each; factory assembled HICO HF-85 preamplifier $30; Shure 16" stereo dynetic $61; 2 HICO 28-watt stereo power amplifiers $35 each; 2 Knight 25-watt amplifiers $38 each; Ampex A-112 $175; Fairchild two-speed 412-2 with case $77; hand-made 3-way electronic crossover $60; HICO AM HFT-94 $37. John Ingram, 2651 Charing Road, Columbus 21, Ohio. HU 6-5134.

SELL: two Dynakit preamplifiers and stereo adaptor, perfect condition, hardly used $60. Dick Loveland, 80 Locust Road, Winnetka, Ill.

WANTED: Marantz electronic crossover, any condition. Otto Fuhrman, 600 Timpson Place, Bronx 55, New York.

Industry Notes . . .

• **Tommer Acquires Control of Gotham Audio.** Stephan F. Tommer formerly a 50 per cent stockholder in Gotham Audio Corp. has acquired all of the outstanding stock interest formerly held by Hal Michael as of February 23, 1962. Mr. Michael, who resides 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, Beyer, Lyrec, Bogen-Germany, Vierling and many others. **S. 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 & Co. Inc. is undergoing a realignment of functions, according to Walter O. Stanton, President. The move coincides with the introduction of a new product line at the May Parts Show. Two major personnel changes have occurred: C. R. "Ray" Bennett has moved into the sales liaison post as Dealer-Merchandising Manager, and J. E. Fox has become Planning and Product Manager. The new West Coast regional office will be run by R. H. "Matt" Matthews. The job of Sales Manager held by George Petetin who recently moved to a sales spot with Reeves-Soundcraft in Danbury, Conn. no longer exists. The present realignment includes the functions covered by Petetin.

• **Norman Sanders Joins University.** University Loudspeakers announced the appointment of Norman Sanders as regional sales manager for the company. Charles Ray, general sales and merchandising manager said Mr. Sanders area of responsibility would include 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 hi-fi department at Leonard Radio in 1946. 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 Barger Box Co., Mishawaka, Ind. was selected on the basis of its high visibility, clean lines, flexibility, and ability to provide the best vehicle for the E-V corporate image. Don Kirkendall, E-V Adv. Manager explained that the changeover would be done as 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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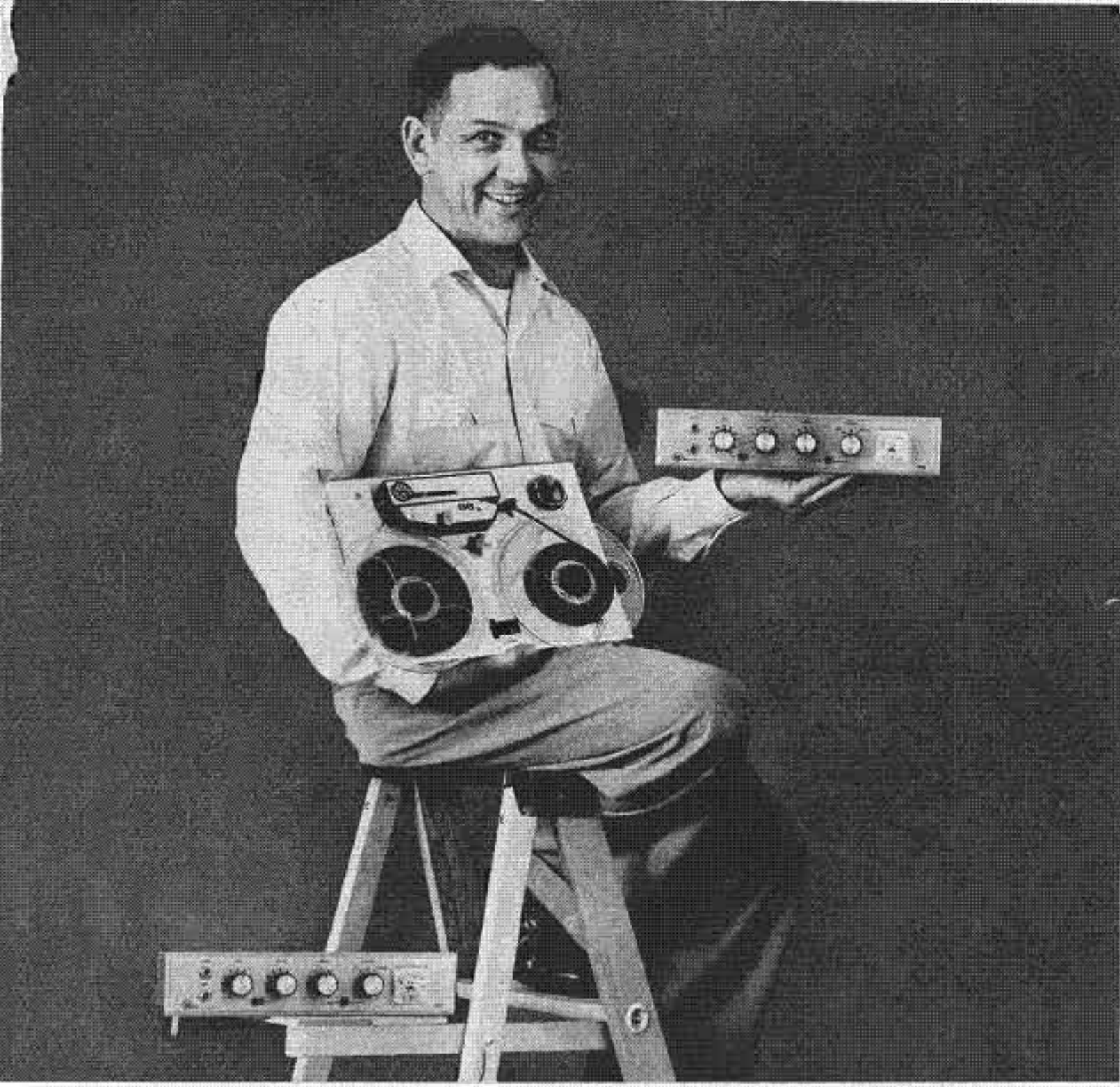

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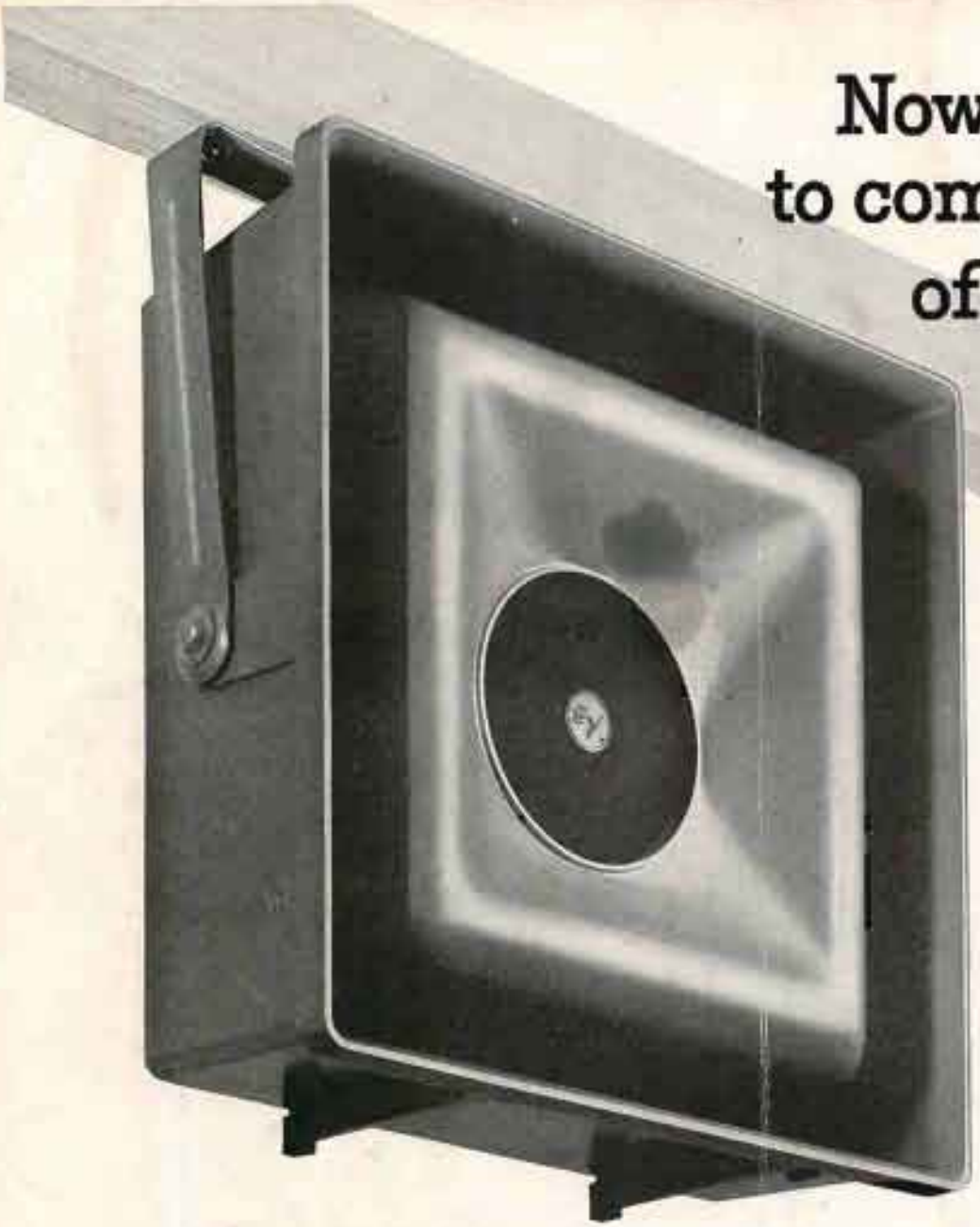

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