AUDIO

MARCH, 1962
50¢

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NEW CIRCUITRY, NEW FEATURES, NEW IDEA IN STEREO

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

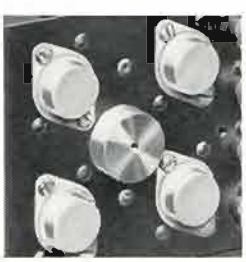
For example, consider its circuitry. Transistors are combined with new frame grid tubes to gain the best qualities of each. As another example, consider its unique stereo headphone facilities. The output receptacle is in the rear; you may leave the headphones plugged in permanently, out of sight when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

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

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DO YOU LIVE NEAR ONE OF THESE STEREO-FM CITIES?

Ariz., Phoenix: KEPI, KNIX
Calif., Fresno: KCIB, KXQR
Los Angeles: KFMU, KMLA
Oceanside: KUDE
Sacramento: KSFM
Santa Barbara: KMUZ
San Diego: KGB, KLRO, KPRI
San Francisco: KPEN, KBAY
San Jose: KSJO
Visalia: KONG
Woodland: KATT
Conn., Newton: WGHF
Dela., Wilmington: WJBR
Fla., Miami Beach: WAEZ, WVCG
Orlando: WHOO
Sarasota: WYAK
Ga., Columbus: WRBL
Ill., Chicago: WEFM, WFMT, WKFM
Rock Island: WHBF
Ind., Evansville: WIKY
Indianapolis: WFMS, WISH
Iowa, Des Moines: KDMI
Kans., Lawrence: KANU
Wichita: KCMB
Md., Towson: WAQE
Mass., Boston (Waltham): WCRB
Lynn: WUPY
Mich., Detroit: WDTM, WGPR
East Lansing: WSWM
Grand Rapids: WJEF, WOOD
Minn., Minneapolis: WAYL, KWFM
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N.J., Dover: WDHA
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N.Y., Garden City: WLIR
New York: WQXR, WTFM
Schenectady: WGFM
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Ohio, Akron: WDBN
Cleveland: WNOB
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Middletown: WPFB
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AUDIO clinic



JOSEPH GIOVANELLI*

Internal Circuit Grounding

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

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

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

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

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

A.C. and D.C. Balance Circuits

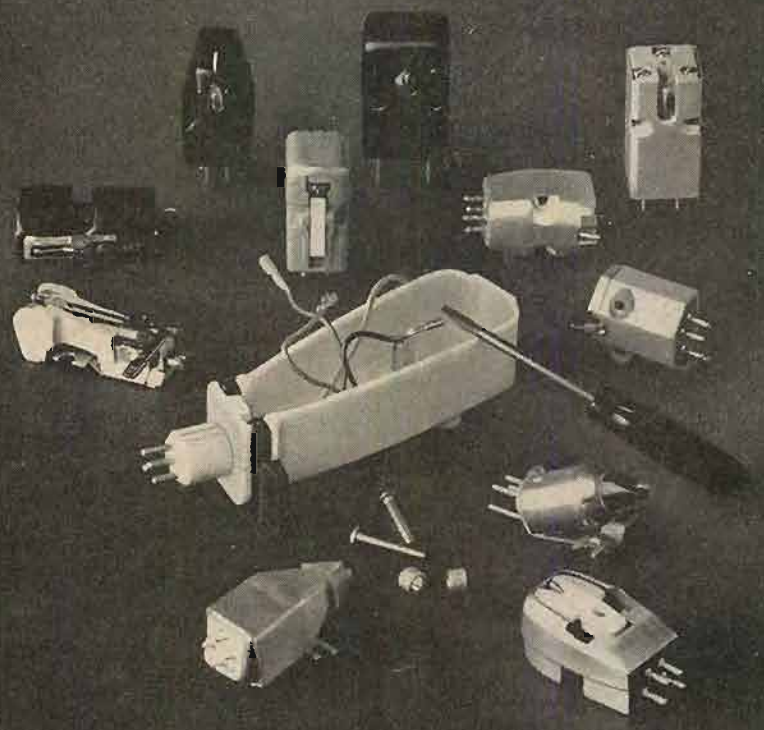
Q. Many amplifiers have pot controls for d.c. balance of the output tubes. Many of the newer amplifiers are appearing with a.c. balance controls as well. What is the advantage or purpose of an a.c. balance control? How is it adjusted? Arthur L. Stanhope, Haddonfield, New Jersey.

A. Let's look at the push-pull output stage to see why we need the a.c. balance control. We want the d.c. adjusted in the push-pull amplifier so that equal current flows through each half of the output transformer. This will prevent saturation of the iron in the transformer. When the iron core of a transformer is saturated, the inductance of the transformer decreases. When the circuit is unbalanced, the d.c. magnetization of one half of the primary of the output transformer is not counteracted by the same force in the other half of the transformer. Even if, under these conditions, no saturation has resulted, the transformer will not be able to handle the amount of audio which could otherwise be handled when the d.c. is correctly balanced. This previously-mentioned fall in inductance is likely to occur during low-frequency passages because these passages contain the greatest amount of audio power. Therefore, these bass tones will not be reproduced cleanly.

It would also be nice if each half of the output stage of the amplifier would recieve the same amount of signal from the driver. This would give maximum power output and minimum distortion because the push-pull action of the stage is correctly functioning. Not only is it a matter of the performance of the stage as a whole, but

* *3420 Newkirk Ave., Brooklyn 3, N. Y.*

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

The a.c. signal conditions discussed here are not applicable to the output stages of amplifiers only. They hold true for any push-pull stage.

Of course excellent performance may be obtained without the a.c. balance control. The use of this type of balance circuit merely imparts the final touch to the equipment—the frosting on the cake as it were.

The Yagi Antenna

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

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

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

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

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

However, this is done with some sacrifice. You somehow never do get something for nothing. Your original dipole would receive signals from two directions in a cardioid

(*Continued on page 38*)

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LETTERS

Higher Harmonics

SIR:

In the January "Letters" column Mr. Richard Simonton stated that he has yet to examine an electronic organ with harmonics higher than 7500 cps. Mr. Simonton, at least three organs (Allen, Artisan, and the new Rodgers) have *fundamentals* up to 8372 cps and some of the mixture stops may have even a higher fundamental. Obviously, the second harmonic of these fundamentals is in the region of 16,000 cps, which is not difficult to achieve since these notes are not pure sine waves. Some of the reeds and strings may actually have harmonics as high as 20,000 cps.

ALLEN A. HEIBECK
2504 Alvord Lane
Redondo Beach, Calif.

Electronic Organs

SIR:

There are some misleading statements in Mr. Wolkov's article in the February issue. First of all, organs which sell for $39 are not really electronic organs—they are reed mechanisms with motor-driven blowers which at best may use electronic amplifiers. The most inexpensive *electronic* organ I know of sells for $300–400. Secondly, Table 1 does not clearly indicate that a pipe of the length shown will produce only the top frequency in the column. For other notes, frequency and pipe length are inversely proportional. However the table is misleading in that the pipe lengths shown generally refer to pitch registers over an entire manual. For example, a 16-foot register would include notes beginning at 32.7 cps (produced by a 32-foot pipe), plus 5 additional octaves.

Thirdly, the author's conception of scale mathematics seems inaccurate. The frequency of each note is the same as that of the previous note multiplied by the 12th root of 2. This ratio produces the correct, tempered scale. Fourths and fifths are "mistuned" *to achieve* the relationship mentioned, not to result in altering it. Briefly stated, the scale is based on a frequency ratio of 2, the octave. The ear hears pitch increments and decrements logarithmically. Thus, to divide a ratio of 2 into 12 parts which will be exactly equal as perceived by the human brain, the factor becomes the 12th root of 2. The reason a tuner hears beats between fourths and fifths is that in this tempered scale the numbers arrived at are irrational, bearing no whole-number relationship.

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

He Wants Meat

SIR:

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

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

DON HASLWANTER
1205 Tyler St.
Glendale 5, Calif.

(*Simple—write to them!* ED.)

What and Why

SIR:

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

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Command RS 831 SD

Ordinarily, records that sound good on equipment of modest frequency range, sound even better when transferred to wide-range equipment whose response is flat enough to satisfy the discriminating listener. Last November, I made a point of the fact that Command's first stereo 35/MM release had impressive sound when played on equipment that rolls off sharply in the high end. The peak in the record's mid range, barely noticeable on a system of limited response, was all too evident on the set up I use every day for review of records and tapes.

During the months that followed the release of "Stereo 35/MM," Volume 1, my reviewing equipment underwent only one significant change: a thoroughly up-to-date stereo cartridge that has improved the sound of virtually every record I own. When Volume 2 of this series came along, I immediately checked it with the new pickup—only to discover that the rise in the record's mid-frequency response is still there and is still objectionable with the new pickup. Rolling off the upper end doesn't help. The record fails to respond to moderate change of tone controls the way other discs do these days. I didn't get rid of the exaggeration in Command's recording curve until I set the preamp's cutoff filter at 7000 cps. Such a recording curve hardly does justice to the sound of the diverting arrangements acquired for the orchestra led by Enoch Light. Phil Bodner's piccolo and Doc Severensen's trumpet roam the upper regions of the scale; a French horn warms the orchestral tonal palette and a tuba underlines the efforts of the lower strings but the highs don't get the break they should. The stereo separation delivers its punch from each channel but I still come away with the conviction that this is not a complete record. What is missing is the flat response above 7000 cps that other labels are furnishing in their releases. Command deserves a great deal of credit for the sound it is turning out in its classical line but this particular series leaves me cold.

Keith Textor: Sounds Sensational!
RCA Victor LSA 2425

Novelty seekers get the best break in sound in the recordings that compromise this month's RCA Victor pop release. The extra demands placed upon the label's technical resources in the Stereo Action series seem to call forth better work from the personnel in the pressing department. Keith Textor's grab bag of sounds involving chorus and percussion is displayed on good surfaces and the response is invigorating. An assortment of RCA microphones has been used at most of the vantage points with the chorus and brass instruments assigned to Telefunkens. The selection on this record destined to get the most demonstration is found on Band 1 of Side 2. The tune is the traditional favorite, *When Johnny Comes Marching Home.* Before the arrangers get him off the battlefield, they unleash some cannon fire that is the most realistic I've heard on stereo discs since the days of Vanguard's 21-gun volley in "The Queen's Birthday Salute" and the Mercury recordings for artillery and orchestra. The only other dubbed-in sound playing a role in the arrangements comes from a small train with a decidedly roguish personality. It circles about while the chorus sings *Down By the Station.* The most effective sounds produced in the studio include the percussion battery that sparks the old Chevalier hit *Mimi* and the tap dancing of Tad Vosburgh picked up on a special platform during the performance of *Tea For Two.* The brief duel between dancer and drums is a particularly clever example of stereo miking. Balancing the busier moments of the program are relaxed treatments of Irving Berlin's *For the Very First Time* and Ben Bernie's old theme song, *It's a Lonesome Old Town.*

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

Robert Mersey: Kean
Columbia CS 8532

Once a record firm acquires the right to release the original cast recording of a Broadway show, other decisions remain to be considered. There's one sure way to learn what a record label really thinks of a musical it has under its wing. If a production shows promise while still in rehearsal, plans are then set in motion to record the score in a variety of instrumental formats. If a show has mixed prospects during rehearsal, instrumental versions may be held in abeyance until the public has had a chance to render its over-the-footlights judgment.

Neither RCA or Columbia has wasted a moment in bringing out orchestral treatments of these two scores. Both shows were obviously considered strong enough to make headway in the market without the benefit of big-name established orchestras. Ray Ellis has appeared in several Victor albums but Robert Mersey is making his record debut in the Kean score. Ellis elects a swinging approach in all the bright tunes from Frank Loesser's "How to Succeed." A wordless chorus backs up the beat of *Love From a Heart of Gold, Happy to Keep His Dinner Warm,* and *Been a Long Day.* A few phrases are sung in *I Believe in You;* the title alone is voiced in *Rosemary. A Secretary Is Not a Toy* is one of the smartest tunes in the original cast album but something seems to happen to it in the conversion. As an orchestral novelty, it sounds for all the world like the *Whistler and His Dog.*

The music from the Robert Wright-George Forrest musical gets a sophisticated treatment in the Robert Mersey arrangements. Most listeners will find his approach in Kean's music a refreshing one. The scoring is fully as colorful as the instrumental show albums put out by Percy Faith and Andre Kostelanetz. Mersey is a native New Yorker who began his professional career as an arranger for the Woody Herman band. He later spent three years arranging and conducting in England. Upon his return to the States, Mersey wrote and arranged music for some of the prestige drama shows on television—while they lasted. If he maintains the workmanship exhibited in his first album, Mersey will soon be a leading name in the specialized field of tastefully-produced orchestral show music.

Kwamina (Original Broadway Cast)
Capitol SW 1645

This musical dealing with the birth of nationalism in present-day Africa ran for only 32 performances in New York. Capitol Records decided, however, to assemble the cast for a recording of the score on the day after the show closed. This move, certainly an unusual one in the record business, was prompted by Capitol's conviction that "Kwamina" did not fail on Broadway because of its music, a point borne out by the press reviews when the show opened. The company felt that the score deserved a wider audience than it was able to garner in the theatre. Richard Adler furnished the music and lyrics that propelled Capitol to its decision. The show's plight, in all probability, stemmed from a plot so advanced in its thinking that even today's audience was not quite prepared to accept it. The Adler score attempted to include two types of African music: atonal incantations of strong rhythmic pattern but no melody and the Bantu music of South Africa with ample melody in its five-tone scale.

From what I have read about the play, I expected a score somewhat along the lines of Kurt Weill's famous "Lost in the Stars" which also had an African locale. "Kwamina" comes closest to that classic in atmospheric pieces such as *The Cocoa Bean Song* as delivered by the entire company and *A Man Can Have No Choice* sung by the owner of one of the best voices in the cast—Brock Peters. The Calypso, originally brought to the West Indies by African slaves, is suggested in the rhythms and double talk of *The Sun Is Beginning to Crow.* Unfortunately, a jarring note is struck just as the scores shows some sign of establishing an identity of its own. In the role of the white lady doctor, Sally Ann Howes, who once played the role of Eliza Doolittle, copies the inflections used by Julie Andrews throughout the second half of Lerner and Loewe's "My Fair Lady." This is a minor point in casting and direction but it may have been one of several factors that led to the show's demise.

Leo Diamond: Foreign Film Themes
Reprise ✪ RSL 1706

King of Kings and Other Film Themes
London ✪ LPM 70050

Imported cars have not been the only European products gaining wide circulation in this country in recent years. Back in the Thirties, European movies were available only in the large urban centers—if you knew someone who could direct you to the right neighborhoods. With luck you might even see an occasional "musical"—the life of Beethoven, perhaps, with a sound track as sour as the visage of the composer. Since World War 2, the burgeoning European movie industry has been sending an increasing number of films to this country. The more recent ones have adopted the Hollywood custom of stressing one or two themes in the backgrounnd score, thereby making possible the tape album now issued by Leo Diamond. We can't complain of a scarcity of Hollywood movie music on records or tapes but comprehensive collections of foreign themes have been a comparative rarity. The only hitch here lies in the fact that you have to take Diamond's harmonica acrobatics along with the more reasonable sound of two pianos, harpsichord, celesta and strings. Diamond has probably earned the gratitude of some listeners in one respect—he doesn't use a zither in the *Third Man Theme.* The best known music from "La Strada" and "Never on Sunday" is given a bolero tempo. Among the dozen tunes are such well-entrenched favorites as *Anna, Carnival* from "Black Orpheus" and themes from "La Dolce Vita," "Rocco and his Brothers," "La Ronde," and "400 Blows."

In the London tape, Frank Chacksfield is asked to abandon his blithe carefree style of former years and don the heavy musical robes of the super-spectacle costume films. He can hardly be blamed if the themes from "King of Kings," "The Robe," "Ben-Hur," and "Quo

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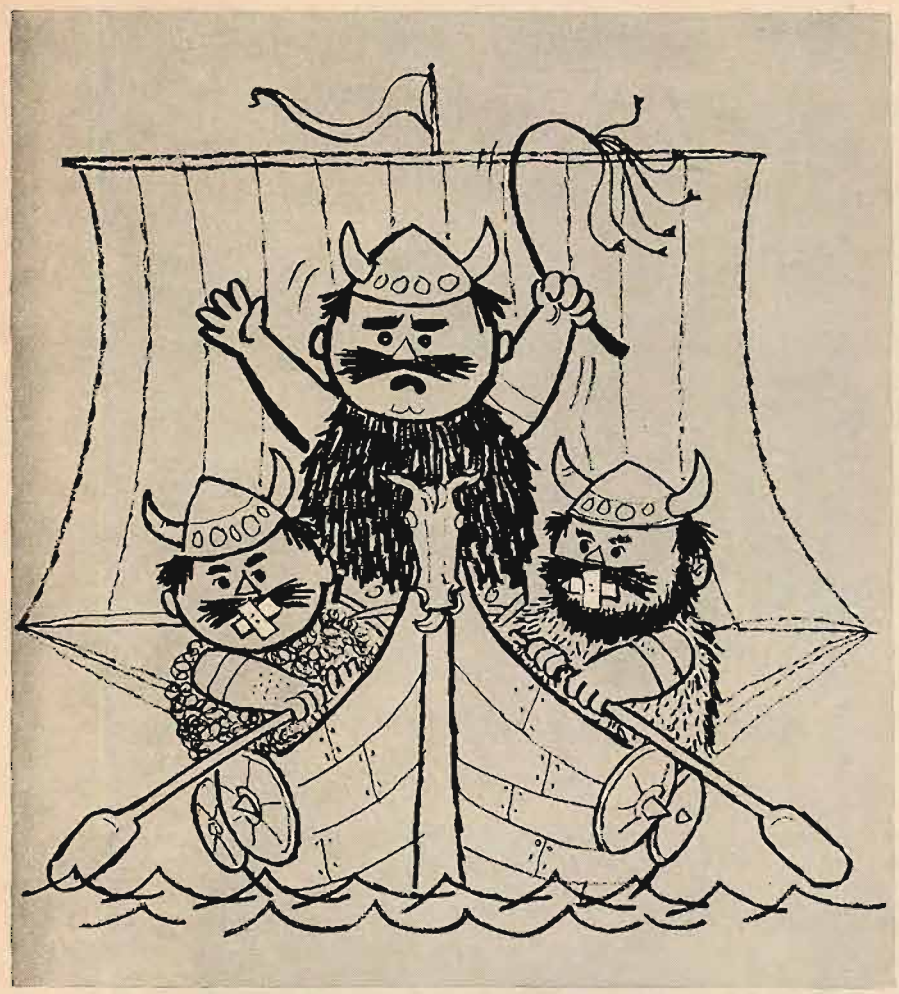
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Vadis" sound pretty much alike. They have to. If they didn't, the producers and the public would feel they were being short changed. The sound on this reel, for all its "heroic" spread, is disappointing. I have a two year old four-track Chacksfield tape on this label ("Evening in Paris"/M 70005) that sounds better in side-by-side comparison.

The Many Voices of Miriam Makeba
Kapp KS 3274

Remember the days when sound-on-sound recording usually involved a loss in listening quality? I was reminded anew of the progress made in multi-track work while listening to the amazingly clean sound that producer Bob Bollard and recording engineer Bob Simpson have provided in the second album by the new singing star from Africa, Miriam Makeba. In songs about warriors and witch doctors, Miss Makeba produced seven voicings—dubbed one at a time—yet the sound loses none of the clarity found in the rest of this recording that is far from average in technical prowess. The first intimation that this is to be a remarkable record comes in the very first selection, a hunting song and boot dance that sends the stamping feet of dancers across the stage to the accompaniment of large African drums, bells and smoothly agile stick rhythms. In the West Indian ballad *Love Tastes Like Strawberries*, the silvery sigh of Ernie Calabria's 12-string guitar, heard on the left, and the low boom of percussion on the right provide a startling contrast as backdrop for the voice. In more sophisticated material—the Carnival theme from the movie "Black Orpheus" and "Night Must Fall"—we find Miss Makeba equally at home in music from other continents. Her crystalline voice is heard to best advantage in a little lullaby about a canary. In its moving simplicity, this one song is enough to confirm the belief of many observers that Mirian Makeba is one of the truly great folk singers of our day.

Mantovani: Music of Victor Herbert and Sigmund Romberg
London PS 165

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

Vienna—City of My Dreams
Columbia WL 156

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

(Continued on page 67)

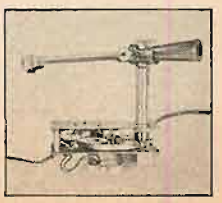
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AUDIO ETC.

Edward Tatnall Canby

LAYMAN'S FM STEREO (MULTIPLEX)

I haven't said a word about FM-stereo for almost nine months. Not since last spring, when the new system was first approved. (I won't count a passing reference to FM-stereo's "phase-2" characteristics, a few issues back.) Good enough reason. It takes awhile for this kind of pudding to cook. And the proof's in the eating, remember. The listening.

It wasn't until almost the end of last year that, very late one night, Miss Sarah Vaughan suddenly belted out a number from one of my stereo loudspeakers, while her accompaniment dribbled forth out of the other. *Stereo!* Well, maybe it wasn't stereo but there sure was plenty of *separation.* I tried my balance control, from one channel all the way over to the other; yes, definitely, *this was it.* The real ping-pong McCoy. There was Miss V., full-bodied, slightly larger than life and much closer, spang in one speaker. On the other channel she was no more than a faint, off-mike, reverberated echo.

My musical ears were not impressed. But my mind said, *by golly, it works.* This is no fake. If La Vaughan can do it, so can Beethoven and Mozart. I mean, maybe, Leonard Bernstein and Leopold Stokowski. If you've got *separation,* you've got everything. (Well, almost everything.)

A Slight Delay . . .

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

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

No blame for the delay in multiplex, then. Far from it. Better an honest delay than a too-hasty launching of imperfect equipment, half-baked. There will always be serious problems in this sort of development that simply cannot be foreseen ahead of time.

What was the layman's likely first move, towards stereo on the air? Well, I figured first I'd like to try a conversion. After all, for some years now we've all had those nicely labeled MULTIPLEX plugs on our tuners, just waiting for a plug-in converter. In any new area, the conversion unit is naturally the first item to be made available. Serves a highly useful, if a temporary purpose. As soon as FM stereo is generally built into most FM tuners of the requisite quality, the conversions will have served their interim purpose and they'll quietly leave the market. So—I'd better begin with a converter.

Well, I never got to one. You see, I had a fine mono tuner sitting in my living room just then, and I figured, why not try the multiplex conversion for *this* tuner, the conversion for which was being heralded, if I remember rightly, back in midsummer. (I was leery of "all-purpose" converters, to fit any mono tuner, and had already heard of some disquieting mismatches, inevitable under the circumstances. Better stick to the same brand, I thought, a specific conversion for a particular model. I note that today one *can* acquire an all-purpose converter, the probable bugs having been mainly worked out and anticipated, out of experience. But this was last August.)

So—an exchange of cordial letters and phone calls with the maker of this fine mono tuner. Then a wait. Further exchange of cordial letters and phone calls. A slight further delay. As I say, I was understanding, and expected just this. Eventually, I got a nice letter saying the conversion unit would probably be available in mid-November. That was fine with me; so I tactfully waited until mid-December (I *do* understand these things. . .) and then tried again. I got back an excellent suggestion from the company: under the circumstances, wouldn't it be more sensible, now, for me to turn in my mono tuner and pick up the new model with the multiplex already built-in? An excellent thought, I decided. For in the meanwhile I had discovered that the conversion unit was not quite of the plug-in sort; there was a certain amount of finger work to be done in the process, like replacing the volume control and power switch. I found, unaccountably, that I had chilly feet at this mild prospect. So I said—yes. Excellent idea. Give me the works—and thus I by-passed the conversion period altogether.

If you will turn to page 46 of the February issue, you'll find our "Equipment Profile" write-up of this very conversion unit, "at long last." Citation MA. The editors sweated out the wait, too, and don't think they didn't expect it, just as I did. A conscientious audio designer is more than likely thus to get out of step with his publicity people, who always get there first with the mostest.

So, as of now, I am still looking forward with utter equanimity to a continued slight delay in receiving the Citation IIIX multiplex tuner, in exchange for the Citation III mono tuner that I still am hanging onto, with the greatest of pleasure. I must say, at this point, that the Citation III has given me, over-all, unusually fine mono FM performance. The longer I wait for Citation IIIX stereo, the more confident I am that the eventual product will be tops. I'll leave Citation there, for the time being, and return to my story about Miss Vaughan.

Pilot's Separation

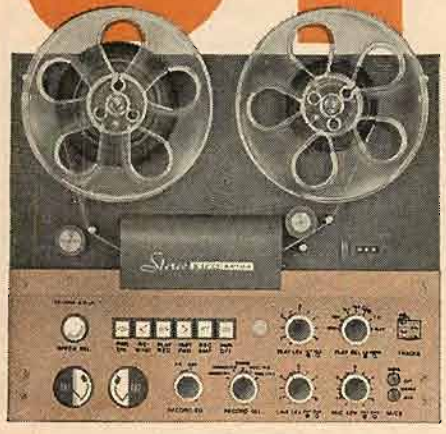
Miss Vaughan, you see, came to me courtesy of another company, Pilot. (It *was* another company. Since then, I discover to my astonishment, Pilot has been bought by a corporation that also owns Harman-Kardon, maker of the Citation line.) Pilot was really on the ball this last year. That company somehow got its FM bugs and its designing problems out of the way in relatively short order and, in no time at all (just a few months) came out with workable, buyable, practical stereo equipment. I don't mind saying that it was at the editors' suggestion that I inquired at Pilot to see whether they might have some stereo ready to hear. They did, and I received a Pilot 602M, a moderately priced combination unit, combining stereo amplifier and phono preamp, and so forth, with a multiplex tuner all in a single package.

This was, actually, just what I wanted, in a different category. If you are going to get an idea of practical broadcast stereo for the layman, you must tackle various line of inquiry (a) conversions (b) top-quality equipment and, even more important, (c) modestly priced, intermediate equipment of the sort that really will make or break the multiplex market for components.

Since we've already printed an extensive Equipment Report on this model (AUDIO, January 1962, page 44), I'll concentrate on the actual experience I have had with this very honestly designed piece of equipment. It has already taught me much, both pro and con, about the larger picture in present-time stereo reception, both at my city location, in the heart of Manhattan,

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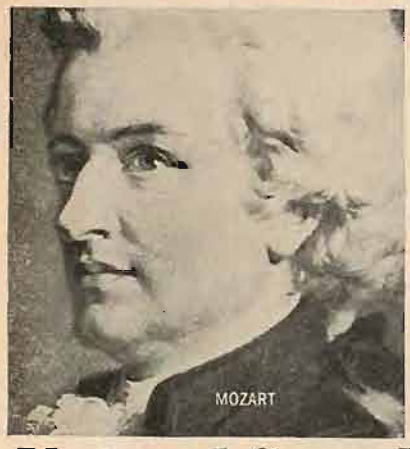
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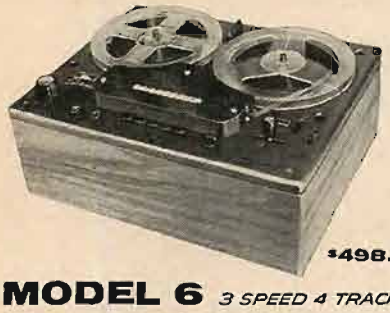
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STEREO RECORD/PLAYBACK TAPE DECK

The remarkable features of this superb unit speak for themselves—records 4 track; plays back 2 and 4 track stereo and mono; records/plays back FM Multiplex Stereocast with magnificent clarity, even at 3¾ ips. Permits sound-on-sound, track adding, direct monitor from source or tape; has push button controls, three separate Tandberg engineered precision laminated heads, hysteresis synchronous motor; installs into HI-FI system. Price $498. Remote control "F" model also available.



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MODEL 65 *3 SPEED 4 TRACK*

STEREO PLAYBACK TAPE DECK

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

Tandberg remains unchallenged for clear, crisp, natural sound!

RE Tandberg OF AMERICA, INC.,

8 THIRD AVENUE, PELHAM, NEW YORK

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

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

Moreover, Pilot resolved another heavy layman's doubt that had bothered me (and bothers others, I am sure). Even with a minimum signal—and a vast roar of background noise—the *separation was excellent.* I had wondered, perhaps innocently, whether separation in any way depended upon signal strength. (I now know that separation can be traded, in the designing, for certain other desired features—if you want them.) Well, it doesn't. Ask Pilot.

Jet Roar

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

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

However, on multiplex, as expected, the thin margin of useable reception I had on hand at this critically distant range was drastically reduced. The hiss became a giant roar, like a nearby jet plane, an immense increase in a heavy bass "rumble." Net result was that though I *could* pick up New York stereo at 100 miles via Pilot, I could not eliminate the background noise to the point where the reception was practical. (I could hear the stereo separation—definitely and reassuringly. Remember that.)

WTFM, our New York all-weather 24-hour stereo station, was always audible but was not quite strong enough to limit the stereo noise background. WQXR's Boston Symphony "live" broadcast (via tape) was considerably weaker, come Saturday night. I could just about make out the music, and confirm that the stereo sound still was there. Five minutes of the jet roar was all I could take of *that.* And nobody else around the East seemed to provide any stereo for me on the occasions when I tried stereo hunting, right across the band. Not a thing. It's amazing, I'm sorry to say, how little stereo there is on the air, even now. Again—this is only to be expected. Let's be realistic. 24 hours a day is an awful lot of time to fill when the hours, days, weeks, months insist on mounting up relentlessly without a break. Still—don't count your stereo chickens too fast. There aren't very many of them, yet.

Let's be realistic, too, about Pilot's 602M and a good many other stereo tuners that fit in the same moderate and popular intermediate category. I said the Pilot was "honest." I mean just that. If I am right, Pilot could have reduced some of this huge roar on weak stereo signals by compromising the stereo itself. (Anybody can do it, of course, by throwing in a low-end filter, to reduce the roar to a hiss; but that also cuts out the bass in the music.) I'm not enough of a technician to know at this point what is involved in the adjustable design parameters here, but I am confident that Pilot's insistence on *real,* 100 per cent stereo separation even at the possible expense of some extra noise as compared with standard (mono) FM, is both an honest approach and a highly valuable one. After all, we are buying stereo and we want the most of it there is. More sensitivity—without stereo compromise—would help, though.

Let's not underestimate this need for extra sensitivity in multiplex stereo reception. It is a drastic need, for all weakish reception and in all fringe areas. On the other hand, in most urban or near-urban areas—which means just about anywhere within 30 or 40 miles of a strong station—the sensitivity factor is not so important. There is plenty of reserve and more, in any reputable component tuner—though I wouldn't say as much for some of the weak-sister FM receivers of the table-model sort I've had occasion to run into.

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

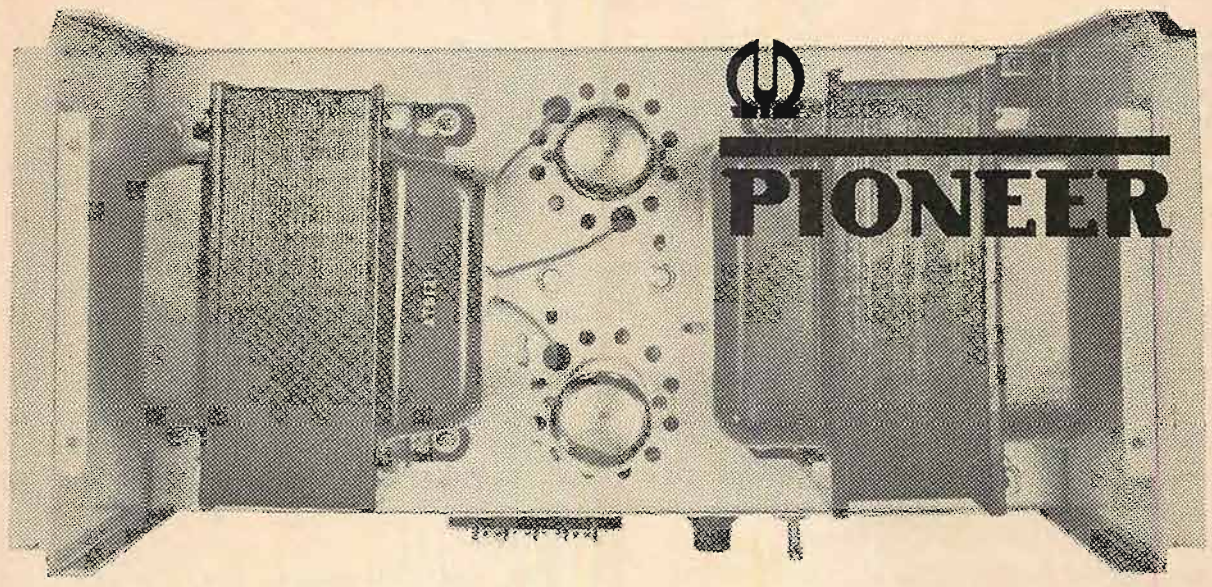
Moral: Beware of fringe reception if you buy stereo; get the most sensitive tuner you can possibly pay for. But if you are in a normal location with good, *strong* signals, receivable on an ordinary folded dipole inside the house (or if you have a better antenna outdoors or in the attic that gives the equivalent), you can buy a Pilot or similar tuner with expectation of complete background silence on FM broadcasts—and via the Pilot I can guarantee, first-hand, that you will *hear stereo.*

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

* * *

I note also that current issues of AUDIO are so full of stereo multiplex tuner ads that I am left gaping with astonishment, and hope that you-all out there understand two things. First, that I am unable to try 'em all, not even in a year, let alone day after tomorrow. And, second, that I chose Pilot for preliminary trial last fall because the Pilot company did get into practical production (as opposed to advertising) very quickly and, last autumn, was clearly one of the few companies out in front in the big race. Things have changed—now there are rivals on every hand, as you may see by looking about you on these pages. I trust that my early experience with Pilot will serve usefully for you layman readers, whatever brand of tuner you try out for yourself, as of now. Æ

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Highest Output For Best Quality

Professional Quality Basic Amplifier

With Amazingly Low Distortion

100 - Watt Basic Amplifier **Model HF-90M**

1. Silicon diode with high regulating capability is used in rectifier circuit to produce a powerful output of 80 watts without distortion. This unit is so compact that it may be conveniently installed or moved around.
2. One of the most distinguished features of the HF-90M is superb low-frequency characteristics which are rarely found in other amplifiers. The distortion-free output (distortion reduced to 1%) is 75W at 30 cps and 50W at 20 cps.
3. This amplifier uses a large output transformer with a core of 5⅛" × 4⅛" × 1¾", the same in size with that of a power source transformer. Such a large output transformer usually has rather poor high-frequency characteristics and it is difficult to apply negative feedback. In order to overcome such defects, this amplifier has specially designed tertiary coil so that a great deal of stabilized negative feedback may be applied.

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

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



Specifications:

Electron tubes: 3 tubes, 2 silicon diodes, Selenium rectifier
Circuit system: 6CA7PP Fixed bias
Gain: 0.9V, 80W at 1Kc
S N ratio: More than 75db
Output terminal: 4, 8, 16 ohm
Maximum output: 100W
Distortionless output: 80W (Less than 1% distortion at 1Kc)
Frequency characteristics: 20 c/s—30Kc ± 1db
Residual noise: Less than 1.5W (at the lowest level)
Voltage: 100, 117V (changeable)
Power consumption: 200W
Dimensions: 14-7/16"(W)×8-1/16"(D)×7-1/16"(H)
Weight: 33.07 lbs



SM-Q300

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40-WATT FM/AM/AM
STEREO TUNER AMPLIFIER



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EDITOR'S REVIEW

PERFORMANCE, *Si!*

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

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

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

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

STANDARDS

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

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

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

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

MEMORABILIA

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

In addition, we invite you to gaze into your crystal ball and predict what you think the next fifteen years holds in store for the high-fidelity field. Do not feel restricted, make your predictions as technical or non-technical as you wish or are capable of. We will tabulate all the predictions and report the results in May. Fifteen years from May it will make interesting reading for any of us still around.

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COMPARES...



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STANTON

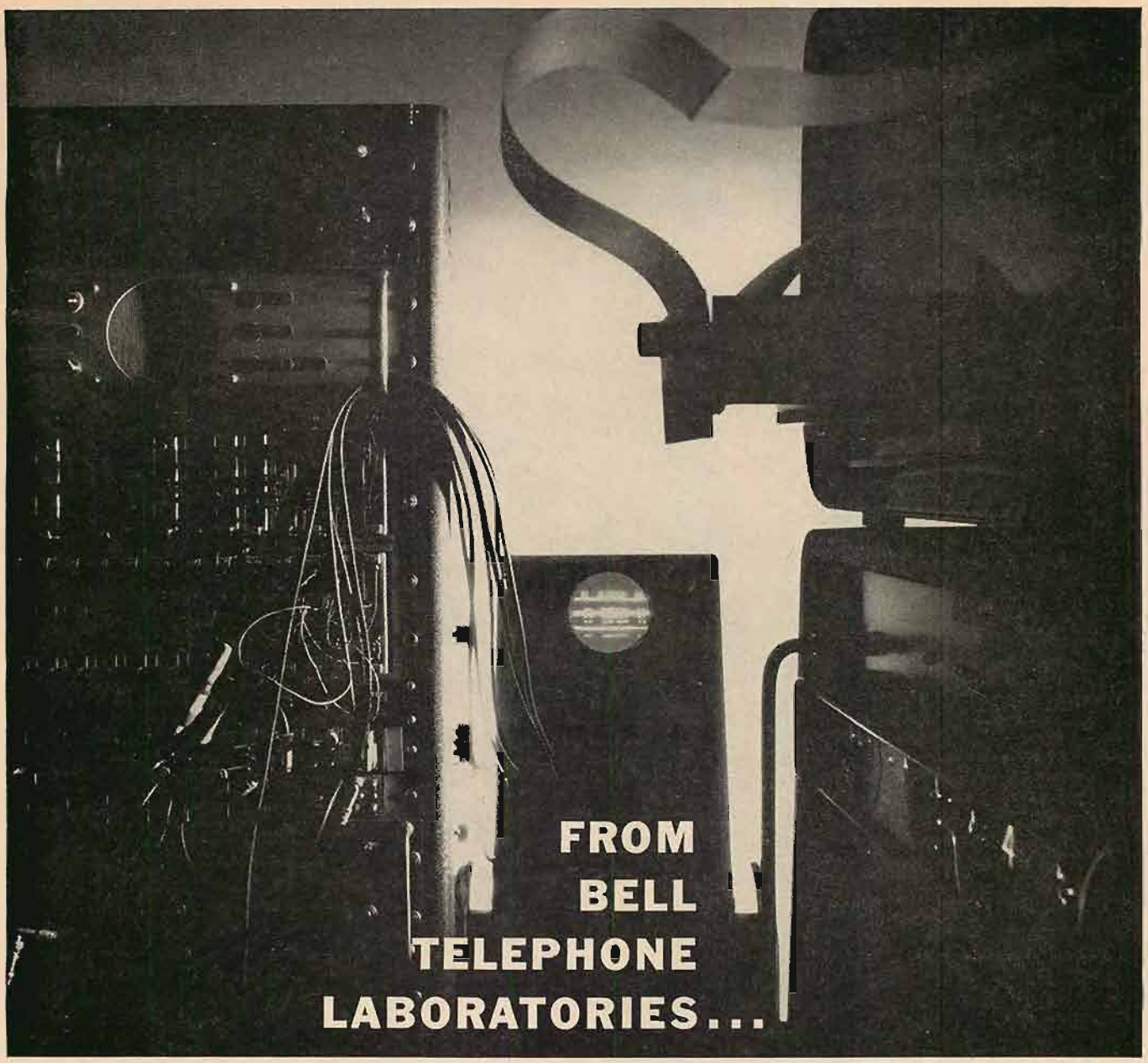
stereo fluxvalve pickup

PICKERING & COMPANY INC. offers the stereo fluxvalve pickup in the following models: the Calibration Standard 381, the Collector's Series 380, the Pro-Standard Mark II and the Stereo 90. Priced from $16.50 to $60.00, available at audio specialists everywhere.

"FOR THOSE WHO CAN HEAR THE DIFFERENCE"

Pickering and Company—Plainview, Long Island, New York

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The fundamental capabilities of pulse transmission are under study at Bell Laboratories. At a transmission rate of 200 million bits per second, for example, PCM could simultaneously transmit 3000 telephone conversations on a single circuit.

AN INTRIGUING DEVELOPMENT IN TELEPHONE TRANSMISSION

Bell Laboratories engineers have applied a method of transmitting telephone conversations which uses a series of ON-OFF pulses rather than the continuous electrical signals generally used since the time of Alexander Graham Bell's first famous message.

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

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

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

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

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

BELL TELEPHONE LABORATORIES

World center of communications research and development

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A High-Quality Stereophonic Mixer

ROBERT GERBRACHT*

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

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

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

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

* *815 S. Chester Ave., Pasadena, Calif.*

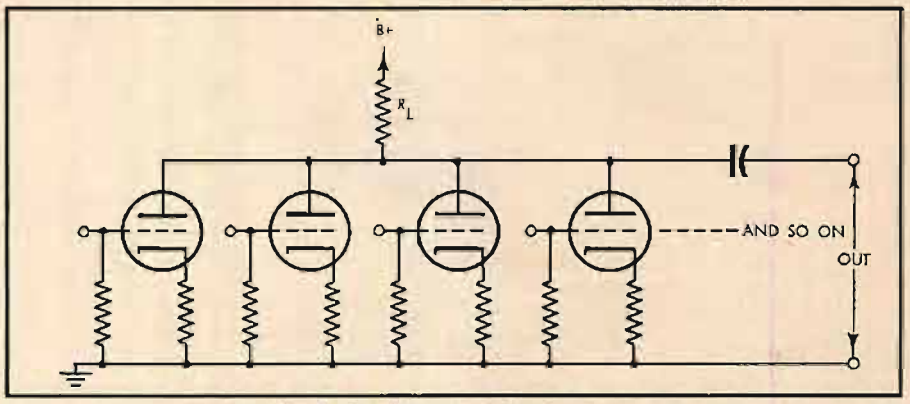


Fig. 2. The "common-plate" mixer.

Design Considerations

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

Magnetic cartridges reqnire equalization and should be terminated in a fixed impedance (usually 47,000 ohms). Without our further discussion it is assumed that the signal from such a cartridge will be amplified and equalized in the usual fashion and presented to the mixer as the (high level) output from some preamplifier. Microphones require no equalization—preamps suitable for high impedance microphones are included in the mixer described in this article. Although low-impedance microphones are often superior to their higher impedance counterparts, the microphone may be terminated in a suitable transformer and the output changed to high impedance with little trouble and moderate expense. Alternately, the outpnt may be sent through a transistor circuit in the



Fig. 1. The completed mixer.

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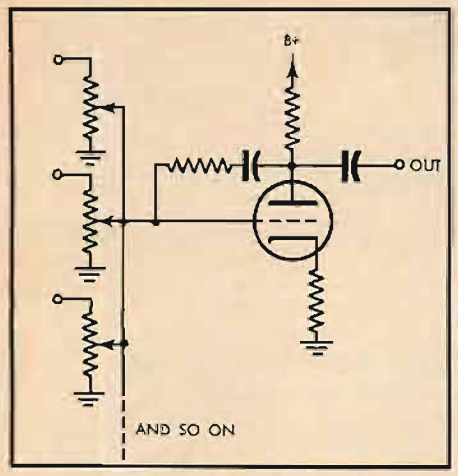


Fig. 3. The "anode-follower" mixer.

contact the signal must be on the order of at least 100 mv, i.e. a high-level signal. Hence all low-level signals must be amplified before the attenuator. This is no drawback, however, since amplification of low-level signals is necessary before mixing anyway.

Probably the most popular and common type of multi-input mixer-amplifier is the common-plate circuit shown in *Fig.* 2. This circuit has the advantage of complete isolation between inputs—no amount of change in the levels of any input has any effect on that of any other, an important requirement for any mixer. On the other hand, one tube section is required for each input. An alternate design, *Fig.* 3, utilizes plate-

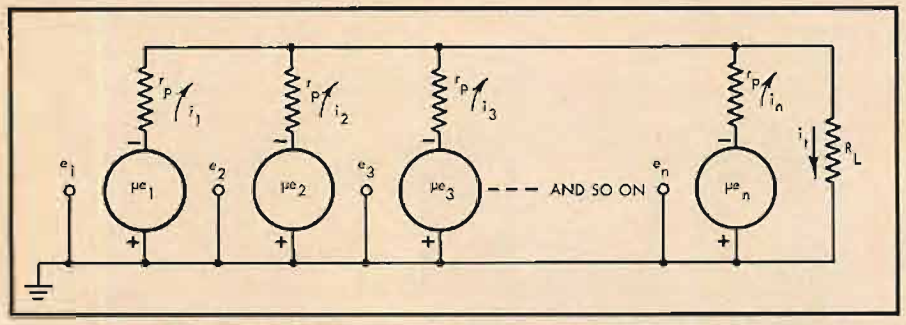


Fig. 4. The equivalent circuit of the common-plate mixer for n inputs.

grounded-base configuration which has the properties of low-input impedance and high-output impedance. From here it may proceed to the high-input impedance preamplifiers. Finally, the output of the mixer may be sent to a cathode follower, thus removing any need for constant output impedance. These considerations simplify the design of the mixing stage considerably.

For a mixer to be a mixer it must have at least two signals to mix—each signal may be high level or low level. This dictates at least four inputs. The demands of stereo double this number. Unless the degree of attenuation must be precisely known, simple potentiometer type attenuators may be used instead of costly step-type controls. However to override the noise from the moving grid feedback in an "anode-follower"[1,2] arrangement to achieve isolation and mixing. However complete isolation is not gained, for grounding one input may alter the output of another signal by some 2–3 db. The common-plate circuit is employed in the mixer described in this article.

Theory of Operation

Figure 4 shows the equivalent circuit of the common-plate configuration for n inputs. R_L is the common-plate load while r_p *and* μ are the tubes' plate resistance and amplification factor, respectively (tubes assumed identical). Here e_o is the signal output while e_j is the jth input signal. Cathode resistors are eliminated for simplicity. Then

$$\mu e_1 + i_1 r_p = \mu e_2 + i_2 r_p = \ldots = -i_T R_L$$

where $i_T = i_1 + i_2 + i_3 + \ldots + i_n$. Hence

$$\mu\,(e_1 + e_2 + \ldots + e_n) + r_p(i_1 + i_2 + \ldots + i_n) = -i_T n R_L$$

so that

$$\mu\,(e_1 + e_2 + \ldots + e_n) = -i_T(r_p + nR_L).$$

But $e_o = i_T R_L$ so that

$$e_o = -\frac{\mu R_L}{r_p + nR_L}(e_1 + e_2 + \ldots + e_n) \qquad Eq.\ (1)$$

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

$$A = -\mu R_L/(r_p + nR_L) \qquad Eq.\ (2)$$

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

Circuit Details

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

[1] Charles P. Boegli, "The Anode Follower," Audio; Dec. 1960, p. 19.

[2] Donald L. Shirer, "Feedback Techniques in Low-Level Amplifiers," Audio; May 1961, p. 19.

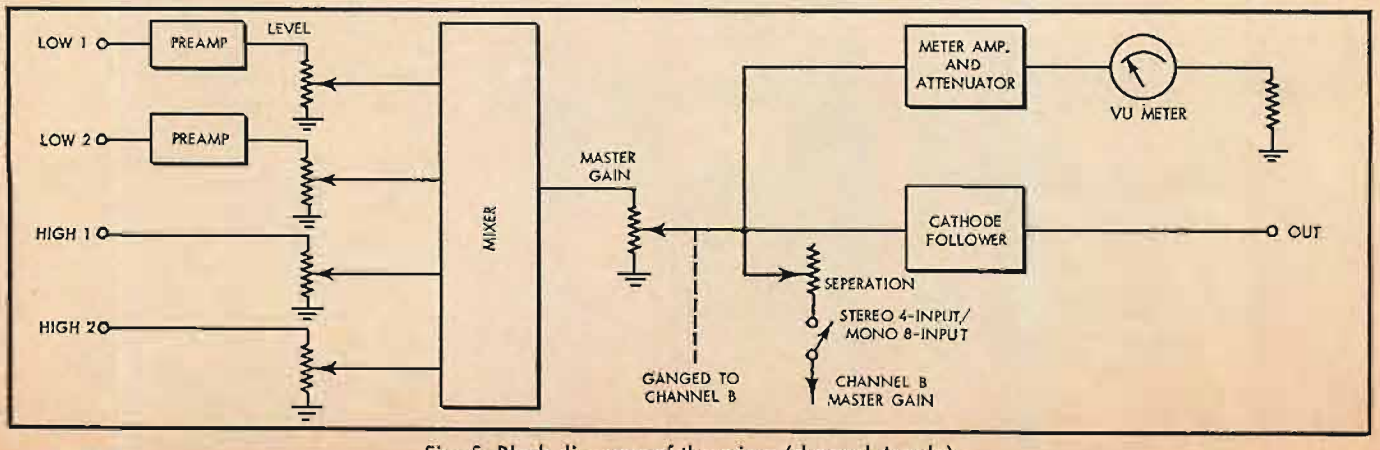


Fig. 5. Block diagram of the mixer (channel A only).

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serves as a visual monitor. A cathode follower completes the circuit.

Figure 6 presents the schematic diagram of the mixer. Only one channel is indicated, the other being identical. The low-level preamp is an almost standard cascode amplifier followed by a voltage amplifier and d.c.-coupled cathode follower. The function of the 120,000-ohm cascode plate resistor has been described by Shirer[2]. A gain of 150 is delivered by the two tubes. The cascode tubes V_1 and V_3 are 12AY7's, a premium low-noise, low-microphonic tube especially designed for low-level amplification, while the cascode circuit is used for its low-noise characteristics. One per cent deposited film precision resistors are used throughout the preamps to ensure low noise. Well filtered d.c. is applied to the filaments of all preamp tubes operating at low-signal levels. Regulated B+ is used throughout to provide exceptional stability and low-hum levels. Large amounts of feedback are applied in the preamps, including the unbypassed cathode resistors, cathode to cathode feedback from V_{2b} to V_{1a}, and, indeed, the basic design of the cascode circuit itself. The output from the preamplifier is flat within 1 db from below 5 cps to 175,000 cps. The cathode resistor of the cathode follower output from the preamplifier is a 100,000-ohm pot and serves as the level control. A spst switch grounds the output when no signal is present.

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

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

$$A = \frac{100 \times 27}{80 + 4 \times 27} = 14.4$$

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

The mixer output is coupled through the .5 μf capacitor to the 100,000-ohm master gain control and the grid of the cathode follower. The latter has a gain of .9 which serves to make the over-all gain for low-level signals exactly 1000, and 7 for the high-level pickups. Two partially isolated outputs are supplied so that, for example, an audio amplifier and tape recorder may receive the signal with output being available at one output jack even if the other is grounded, which sometimes is done in equipment when the input is not being used. The output impedance is approximately 10,300 ohms

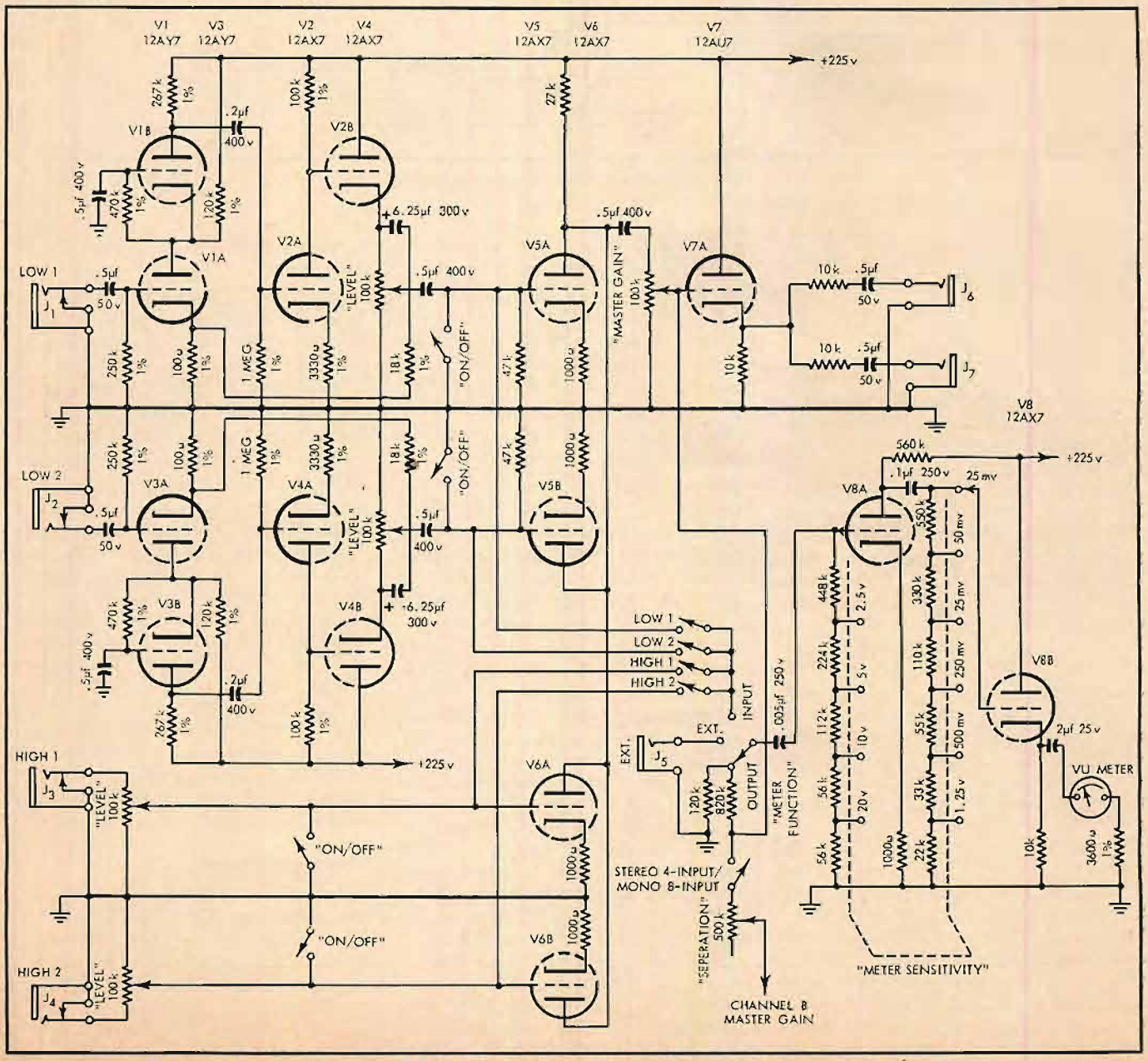


Fig. 6. Schematic of the mixer (only one channel shown, the other is identical).

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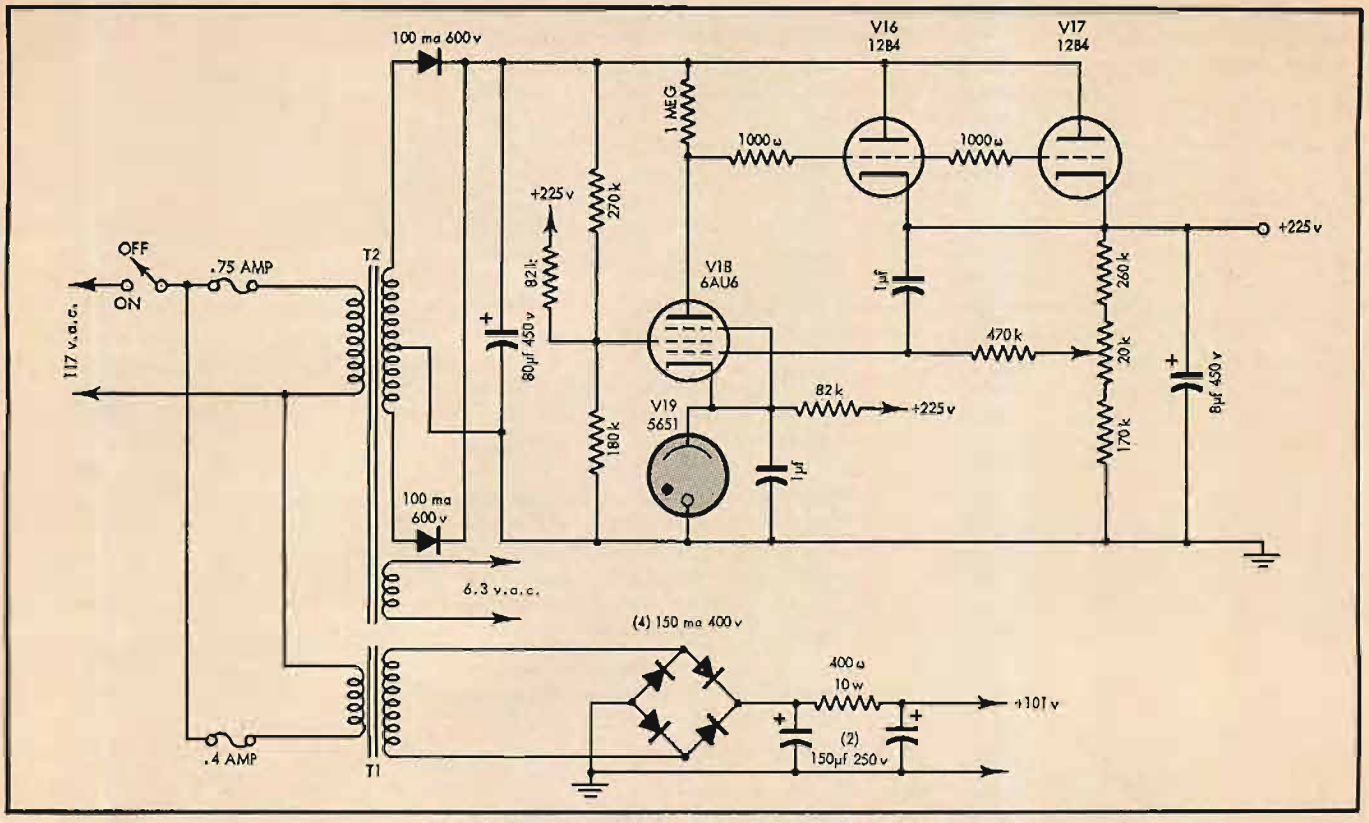


Fig. 7. Schematic of a power supply for the mixer.

which permits the use of an output cable with a shunt capacitance of up to 750 pf before the highest audio frequencies are noticeably attenuated. This corresponds to an output cable length of approximately 30 feet.

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

Input to the meter circuit is from three points. Switches on the front panel send the signal on any or all of the mixer grids through the meter, or the total output of the mixer may be monitored. In the latter position a voltage divider consisting of the 120,000 and 820,000-ohm resistors takes account of the gain of the mixer stage and eliminates the necessity of changing the meter sensitivity switch. A third position is supplied for any external signal, such as that from an audio preamplifier. The meter circuit consists of a voltage amplifier, a step-type attenuator, cathode follower, and the VU meter itself. Tube V_{5a} has a gain of 60 with sufficient bandpass to cover all audio frequencies. The signal is then coupled through the cathode follower to the meter. The amplifier and attenuator permit the meter to register on scale to a wide range of input levels and effectively eliminates the loading effect of the VU meter on the line. The switch positions are labeled by the input signal voltages necessary to give "0" VU deflection on the meter. The resistors of the attenuators were hand picked from a box of standard 10 per cent resistors to ensure their proper values. For example, the 550,000-ohm resistor is actually a 560,000-ohm resistor with somewhat low resistance.

The power supply for such a device must be carefully designed. Hum cannot be tolerated with such low-level signals. Direct current on the filaments is essential to low-hum operation—regulation of the filament supply is helpful, but not absolutely necessary. On the other hand, regulation of plate voltages is necessary for long-term over-all operational stability. It goes without saying that hum on the B+ line must be insignificant. The mixer requires a +225 volt regulated supply at about 65 ma, and filament voltages. In the actual construction of the mixer a slightly modified commercial power supply was used with regulated outputs of +225, +150, and −170 volts. The negative supply at 150 ma was used to supply regulated filament voltages with a series string arrangement to all tubes except those in the meter circuits. (If such an arrangement is used care must be taken to ensure that the 12AY7's are stacked toward the ground side of the line—otherwise the filament-to-cathode voltage ratings may be exceeded.) The 12AX7's will tolerate 200 volts between filament and cathode and thus may safely be placed at the upper side of the filament supply.

A considerably simplified power supply circuit is shown in *Fig.* 7. Here an isolation transformer, T_1, supplies 117 volts of a.c. at an easy 150 ma. This is rectified in a typical full-wave bridge and filtered. This supply sends well-filtered d.c. to the eight preamp tubes operating at low-signal levels. The other tubes and the various pilot lamps are powered from the usual 6.3 volt winding of transformer T_2. Plate voltage is also obtained from this transformer. After rectification and preliminary filtering the output passes through a standard series voltage regulator. The series regulation tubes V_{16} and V_{17} are each rated at 35 ma. The error signal is applied to the grid of V_{18}, a high gain amplifier, through the sliding arm of the 20,000-ohm pot which permits accurate adjustment to +225 volts. A premium 5651 gas VR tube provides a stable reference voltage and completes the tube complement of the supply.

Construction Details

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

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Such leads are found only at the inputs, however, because pots and switches have been positioned near the tubes they serve, thus elimating the usual (and interminable) number of long leads to the front of the chassis and back. Brackets holding the pots have been used, with extension shafts bridging the gap from the pot to the front panel.

For low noise operation precision carbon-film resistors were used exclusively in the preamp stages, with 1 watt resistors throughout the remainder of the construction. Phone plugs are used instead of the usual phono plugs. This permits a more positive connection and also allows the inputs to be shorted when no plugs are in the sockets. It is important that high quality components be used, especially for the potentiometers, otherwise the sliding contact may inject appreciable noise into the line. Shielded tube sockets are also provided for minimum hum, and a bottom plate completes the electrostatic shielding.

In this particular construction extensive use was made of ceramic terminal strips which unfortunately are not readily available commerically. However, any of the customary wiring techniques using terminal boards, printed circuits, or good point-to-point wiring may be satisfactory. The ordinary phenolic terminal strips may also be employed with good results at some sacrifice in space economy. While the chassis width is determined by standard rack panel widths, the depth behind the front panel is arbitrary to a certain extent. The meter circuit may be placed on a front subpanel as in this construction (*Fig.* 8), or positioned on the main chassis of a deeper model. Aside from these particular hints standard wiring practice should be followed for satisfactory results. While not a complex project, the mixer is rather involved, and should be approached with caution by those with limited experience. On the other hand, those familiar with building projects can reasonably expect to achieve a pleasing result with no more than the usual trauma.

The mixer is built on a 17-in. chassis for standard 19-in. rack mounting, although an alternate panel was constructed and the completed instrument placed in a wooden case for aesthetic purposes. A familiar problem to the home constructor is that of capping a successful project with a front panel worthy of the electronics behind. In this case the bare chassis front and subpanel are covered by an aluminum panel, with proper cutouts, which is sprayed flat black. The front panel itself is of Plexiglas. Control designations were etched on the rear of the Plexiglas, and edge lighting is employed with lamps located at the edge of the Plexiglas. The VU meters are also illuminated. Brass plates are employed on either side as a convenient way of anchoring the eight toggle switches. Decals were used to complete these, and the brass pieces then covered with lacquer. A polished brass bar divides the panel horizontally, with brass knobs purchased form a well-known component manufacturer completing the front panel design. The finished chassis is slid in from the rear and bolted to the cabinet bottom. The result is shown in *Fig.* 1.

Operation and Performance

The rated output of the mixer is taken to be 1 volt. This is sufficient for nearly all purposes—if not, the mixer will deliver outputs up to six volts without appreciable distortion. The sensitivity for

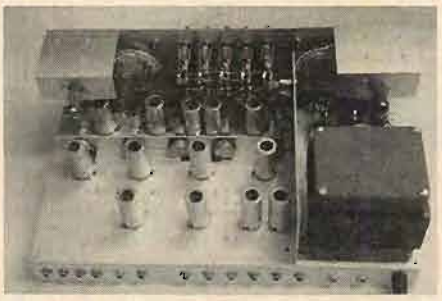


Fig. 8. Top view of the completed mixer.

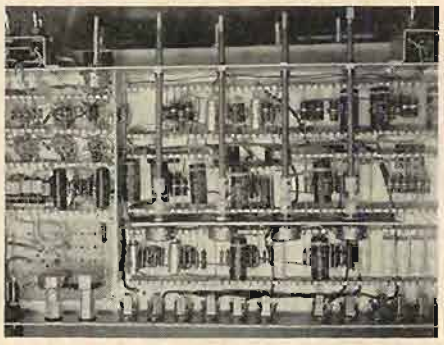


Fig. 9. Bottom view of the completed mixer.

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

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

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

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

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

PARTS LIST—*Mixer*

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

(*Continued on page 53*)

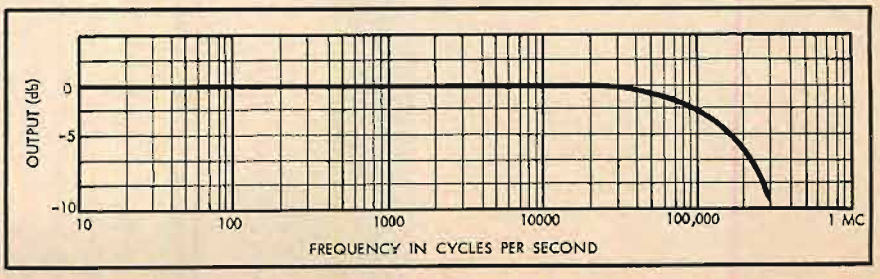


Fig. 10. Over-all frequency response with a low-level input: $e_{in} = 5$ mv, $e_{out} = 5$ volts (0 db).

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The Frequency-Response Specification

MANNIE HOROWITZ

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

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

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

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

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

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

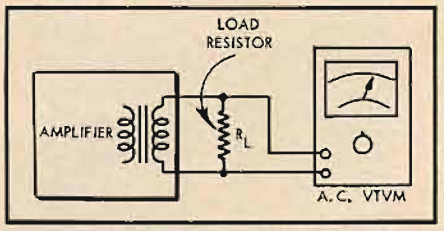


Fig. 1. Output measuring circuit.

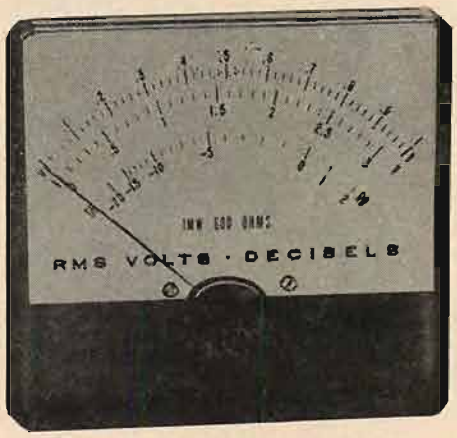


Fig. 2. Standard meter face.

The Decibel

The decibel is defined by the simple equation:

$$db = 10 \log_{10} P_o/P_i \quad Eq.\ (1)$$

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

$$db = 10 \log P_o - 10 \log P_i \quad Eq.\ (2)$$

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

In these tests, all measurements revolve about the $10 \log P_o$ term. In the actual test procedure, the K term is adjusted for a specific power reading at the output of an amplifier, for some frequency in the middle of the audio range. The central frequency is usually

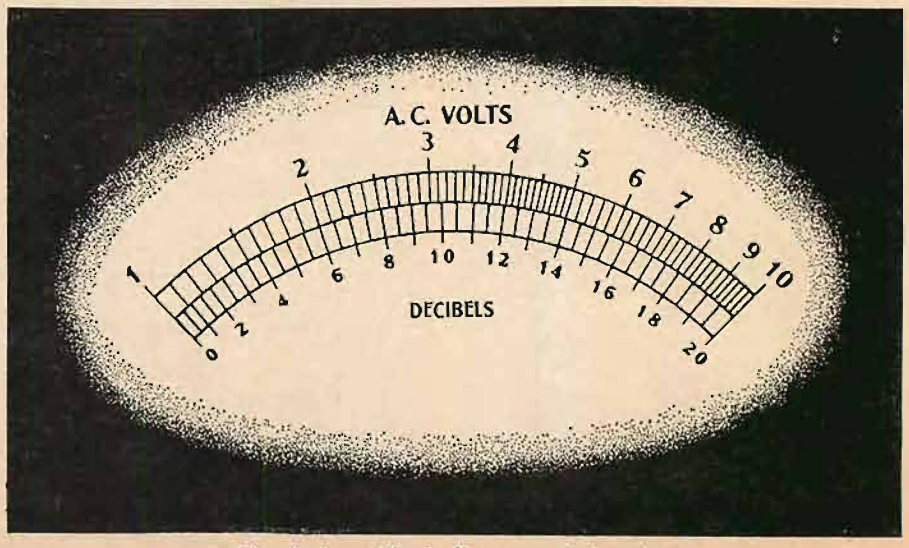


Fig. 3. Logarithmically expanded scale.

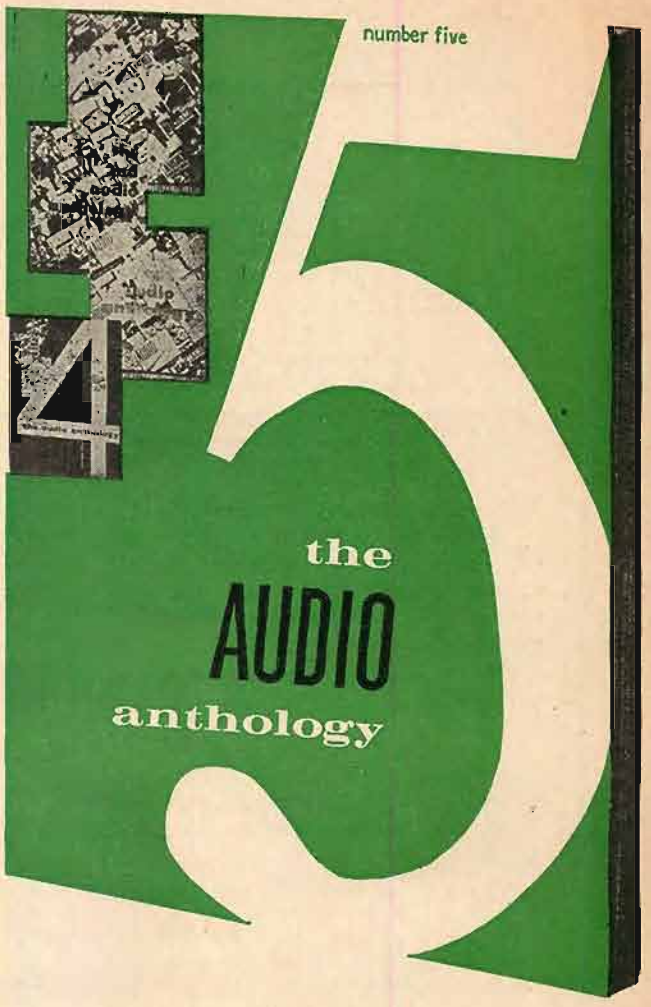
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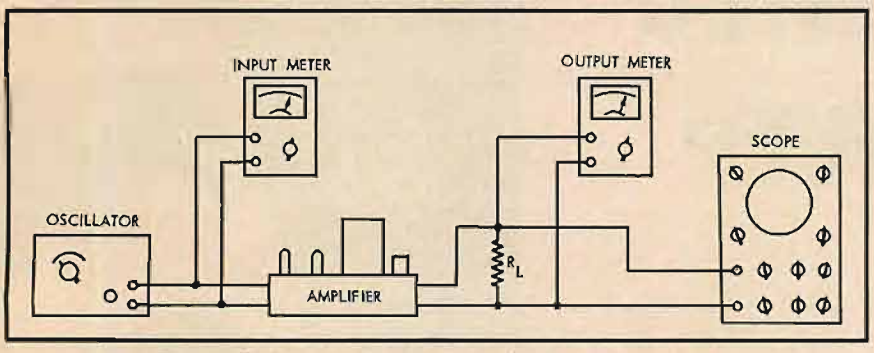


Fig. 4. Circuit used to measure frequency response.

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

The equation for gain at 1000 cps is:

$$db\ (1000\ cps) = 10 \log P_o\ (1000\ cps) - K \qquad Eq.\ (3)$$

For example, let us find the difference in gain (in db) at 100 and 1000 cps. First, write the counterpart of *Eq. (3)* for 100 cps:

$$db\ (100\ cps) = 10 \log P_o\ (100\ cps) - K \qquad Eq.\ (4)$$

The db variation at 100 cps from the reading at 1000 cps is found by subtracting *Eq. (3)* from *Eq. (4)*, if the gain at 100 cps is greater than the gain at 1000 cps or subtracting *Eq. (4)* from *Eq. (3)* if the gain at 1000 cps is greater than the gain at 100 cps.

$$db\ (1000\ cps) = 10 \log P_o\ (1000\ cps) - K$$
$$-\ [db\ (100\ cps) = 10 \log P_o\ (100\ cps) - K]$$
$$\therefore db\ (1000\ cps) - db\ (100\ cps) = 10 \log P_o(1000\ cps) - 10\, P_o(100\ cps) \qquad Eq.\ (5)$$

The input term drops out in the final equation. The resulting equation involves only the deviation of the log of the output power at 100 cps from the log of the output power at 1000 cps.

Another way of expressing the difference in gain at 1000 cps and 100 cps is

$$\Delta\ db = 10 \log \frac{P_o\ (1000\ cps)}{P_o\ (100\ cps)} \qquad Eq.\ (6)$$

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

A straightforward procedure consists of measuring the output voltages at 100 and 1000 cps calculating the power at each frequency from V_o^2/R_L, and substituting these into *Eq. (6)* to determine the db difference at the two frequencies. Converting the equation to read directly in voltage would be much simpler, saving two calculations.

Consider the output power at 1000 cps to be equal to $P_o\ (1000\ cps) = V_o^2\ (1000\ cps)/R_L$ and the output power at 100 cps to be equal to $P_o\ (100\ cps) = V_o^2\ (100\ cps)/R_L$. Substituting these into *Eq. (6)* yields:

$$\Delta\ db = 10 \log \frac{V_o^2\ (1000\ cps)/R}{V_o^2\ (100\ cps)/R}$$
$$= 10 \log \left(\frac{V_o\ (1000\ cps)}{V_o\ (100\ cps)}\right)^2$$
$$= 20 \log \left(\frac{V_o\ (1000\ cps)}{V_o\ (100\ cps)}\right) \qquad Eq.\ (7)$$

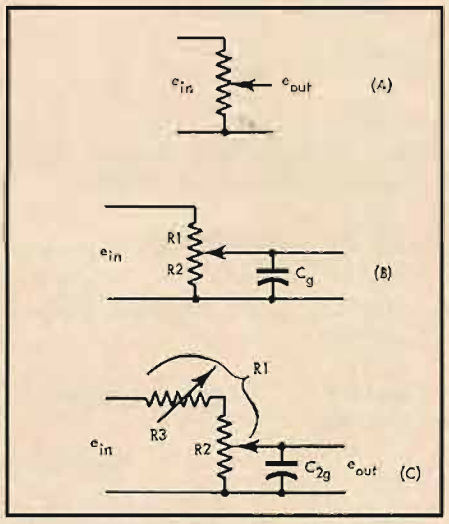


Fig. 5. Ideal level control, (A); more accurate representation of a level control in a circuit, (B); realistic circuit of level control in conjunction with conventional stereo balance control, (C).

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

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

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

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

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

Another type of a.c. meter, extremely popular in the audio field, uses a sup-

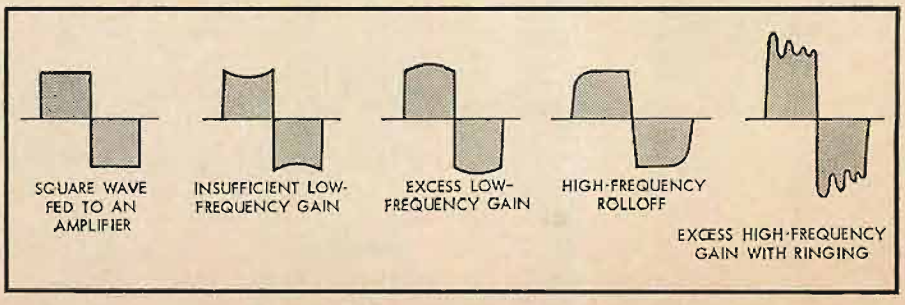


Fig. 6. Testing with a square wave.

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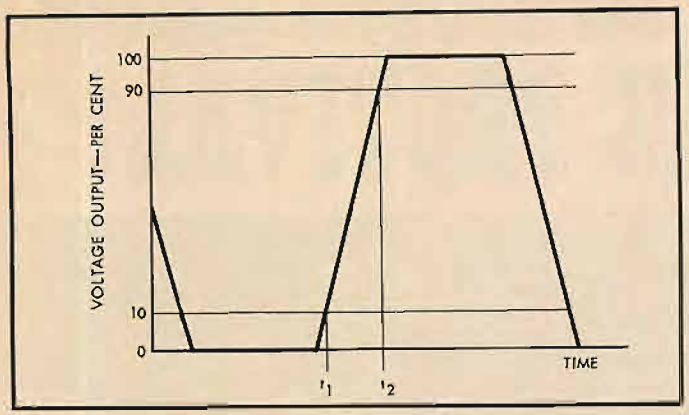


Fig. 7. Square wave with measurable rise time. Rise time is $t_2 - t_1$ and is defined as the time required for the output to rise from 10 per cent to 90 per cent of its final value.

pressed zero movement, as shown in *Fig.* 3. The scale does not start with zero and is essentially logarithmic in character. If this type of meter is used, each time the range is switched, it represents a change of 20 db rather than 10 db.

The Measuring Circuit

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

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

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

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

$$Y_2 = \frac{1}{X_2} = \frac{1}{R_2} + j\omega C = \frac{1 + j\omega C R_2}{R_2}$$

so that the reactance becomes

$$X_2 = \frac{R_2}{1 + j\omega C R_2} \qquad Eq.\ (8)$$

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

$$\frac{e_{out}}{e_{in}} = \frac{R_2/1 + j\omega C R_2}{R_2/1 + j\omega C R_2 + R_1} \qquad Eq.\ (9)$$

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

$$\frac{e_{out}}{e_{in}} = \frac{R_2}{R_1 + R_2 + j\omega C R_1 R_2} \qquad Eq.\ (10)$$

Multiplying this equation by

$$\frac{R_1 + R_2}{R_1 + R_2}$$

results in

$$\frac{e_{out}}{e_{in}} = \frac{R_2/R_1 + R_2}{R_1 + R_2/R_1 + R_2 + \dfrac{j\omega C R_1 R_2}{R_1 + R_2}} = \frac{R_2/R_1 + R_2}{1 + \dfrac{j\omega C R_1 R_2}{R_1 + R_2}}$$

The frequency at which the response is 3 db from the center value is reached when the denominator takes the form $1 + j$, *or*

$$\frac{j\omega C R_1 R_2}{R_1 + R_2} = j$$

$$\text{and } \omega = \frac{R_1 + R_2}{R_1 R_2 C} \qquad Eq.\ (11)$$

The frequency response is thus a direct function of the relative values of resistors R_1 and R_2.

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

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

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

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

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

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

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

The theoretical square wave has a zero

(*Continued on page 67*)

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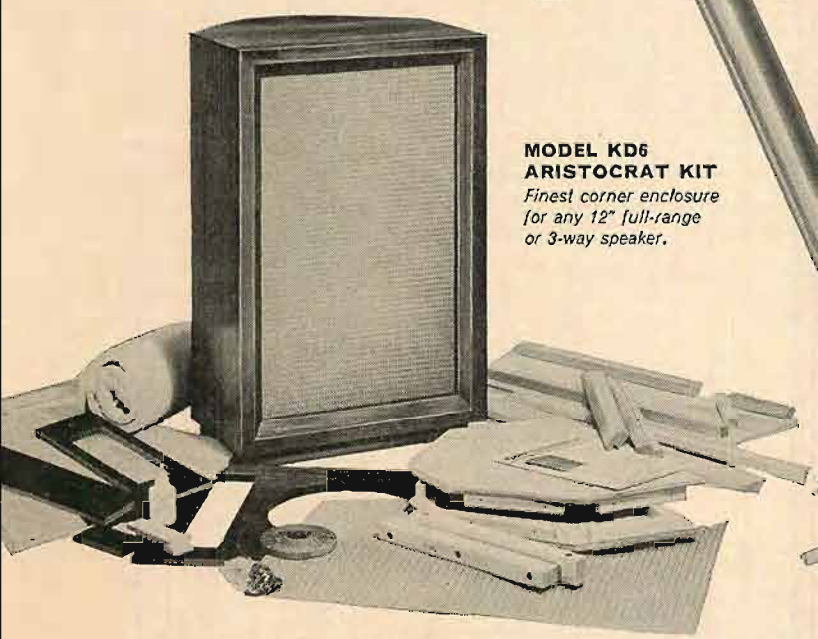
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Electronic Organ Tone Generators

D. WOLKOV*

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

In Two Parts—Part 2

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

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

* *10 Sunbeam Rd., Syosset, N.Y.*

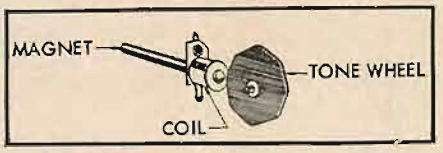


Fig. 14. Hammond tone generator.

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

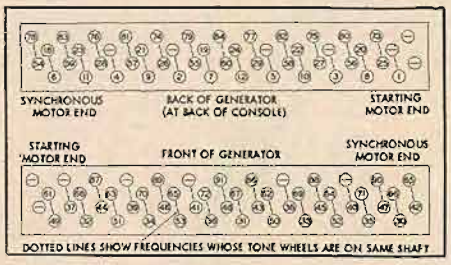


Fig. 15. Magnet locations on Hammond tone generator.

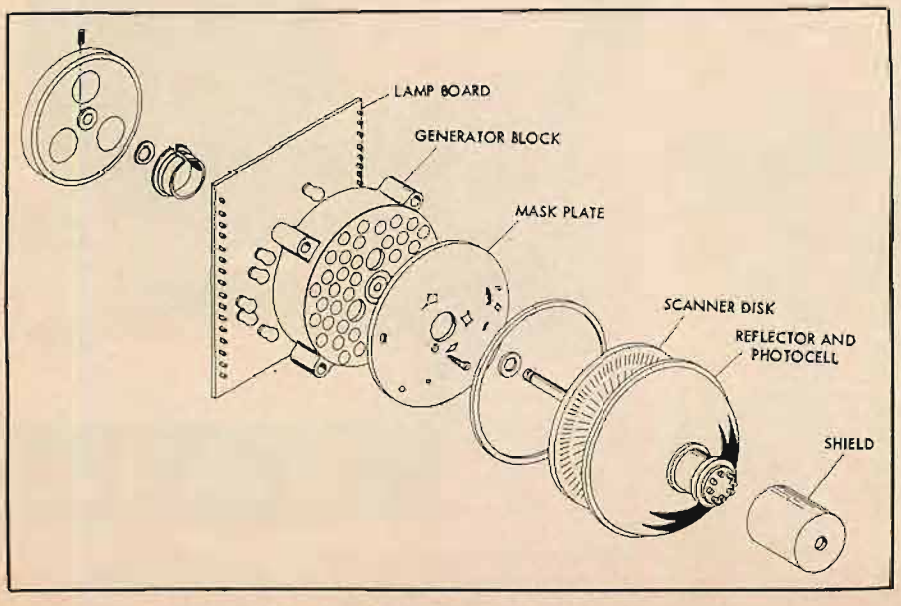


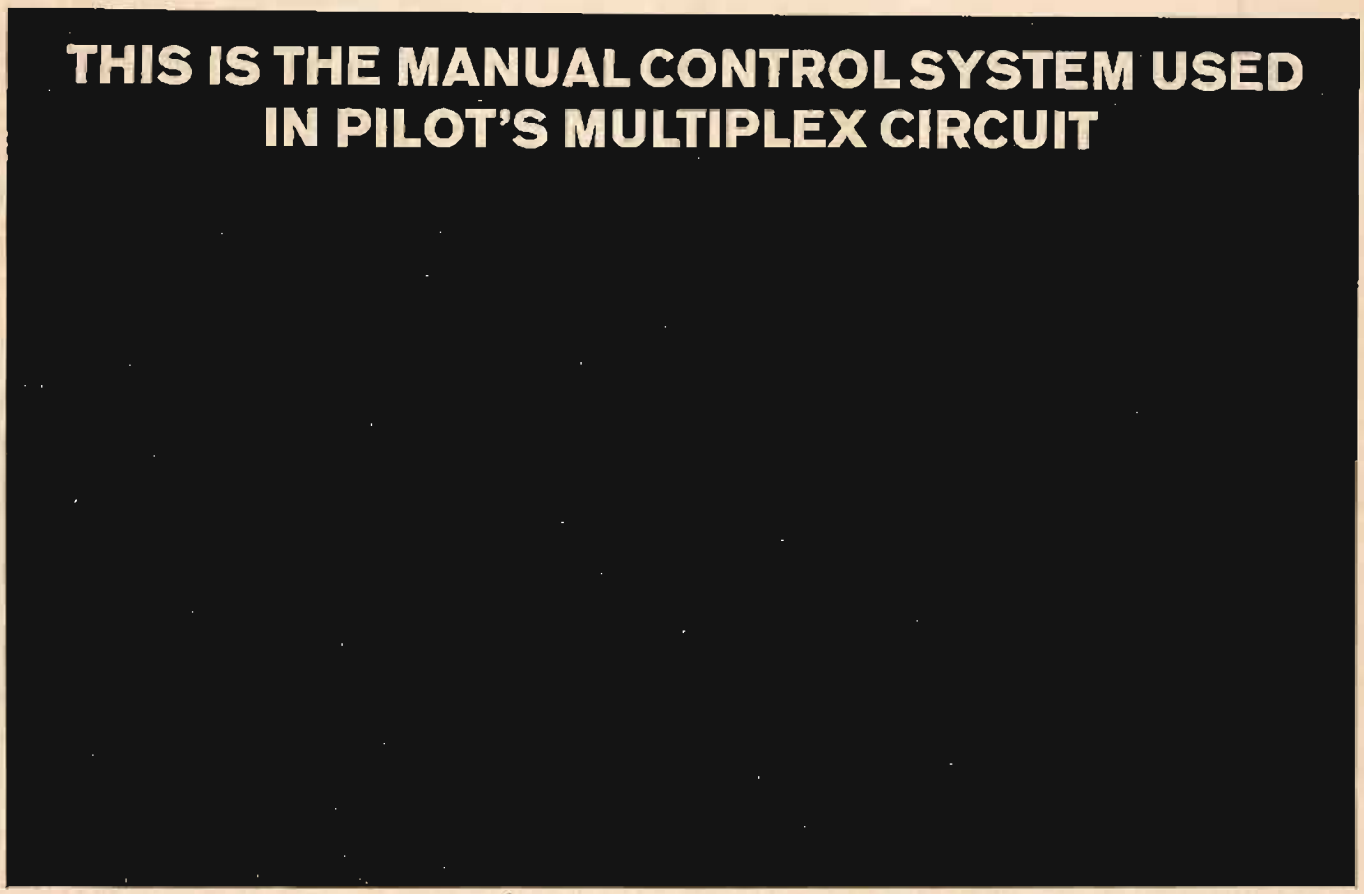
Fig. 13. Kimball photo-electric tone generator.

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

In contrast to the systems just described, single-frequency sine waves are produced in the Hammond tone-generator assembly. The Hammond generator contains 91 "tone wheels" driven at predetermined speeds by a motor-and-gear arrangement. Each tone wheel is a steel disc similar to a gear with high and low spots on its edge (see *Fig.* 14). As the wheel rotates, these teeth pass near an associated permanent magnet. The resulting variations in the magnetic field induce a voltage in a coil wound on the magnet. The twelve lowest tone-generator wheels are specially cut to be rich in odd harmonics and are used only in the pedal combinations. Each pair of tone wheels is mounted on a shaft and between them is a Bakelite gear held between two coil springs forming a mechanical vibration filter. As the gear is not rigidly attached to the shaft, any pair of wheels which might be stopped will not interfere with the operation of the others. On top of the Hammond tone generator assembly are small transformers and capacitors forming tuned

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THIS IS THE MANUAL CONTROL SYSTEM USED IN PILOT'S MULTIPLEX CIRCUIT



No, we haven't forgotten anything. We designed it that way. There are **no** "user-operated" controls. This is only one of the many features that makes PILOT's unique signal sampling Multiplex circuit*—used in all PILOT Multiplexers, Stereo Receivers and Stereo Tuners—simpler, more effective and more trouble-free than any circuit presently being manufactured for stereo demodulation.

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

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

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

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

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*Patent Pending

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filters for the higher frequencies (see *Fig.* 15). The design of the organ is such that the fundamental and harmonics may be mixed by the performer in varying amounts. This method permits the generation of a multiplicity of complex patterns for each fundamental note.

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

While the Kinsman oscillator is essentially of the grounded-plate variety, there is a plate load R_3 so that output can be taken from the plate. The values of C_3 and C_4 are such that a sawtooth pulse is produced.

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

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

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

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

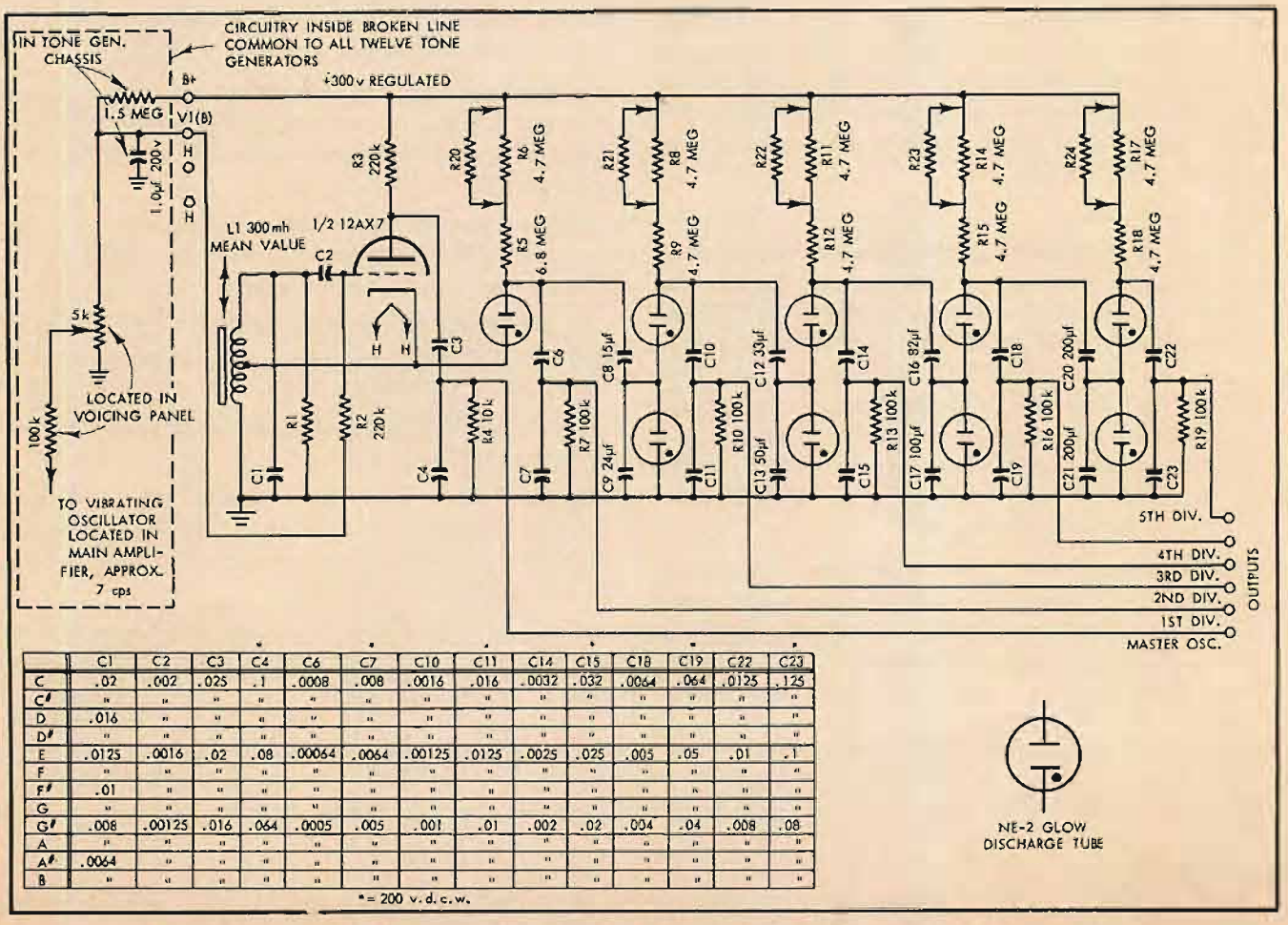
With the correct selection of sync amplitude and timing values (resistors and capacitors), the two lamps may be made to fire only once for every two cycles of the synchronizing frequency. Thus, frequency division can be accomplished. Reference 10 contains a complete analysis of the Kinsman two-neon-tube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

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

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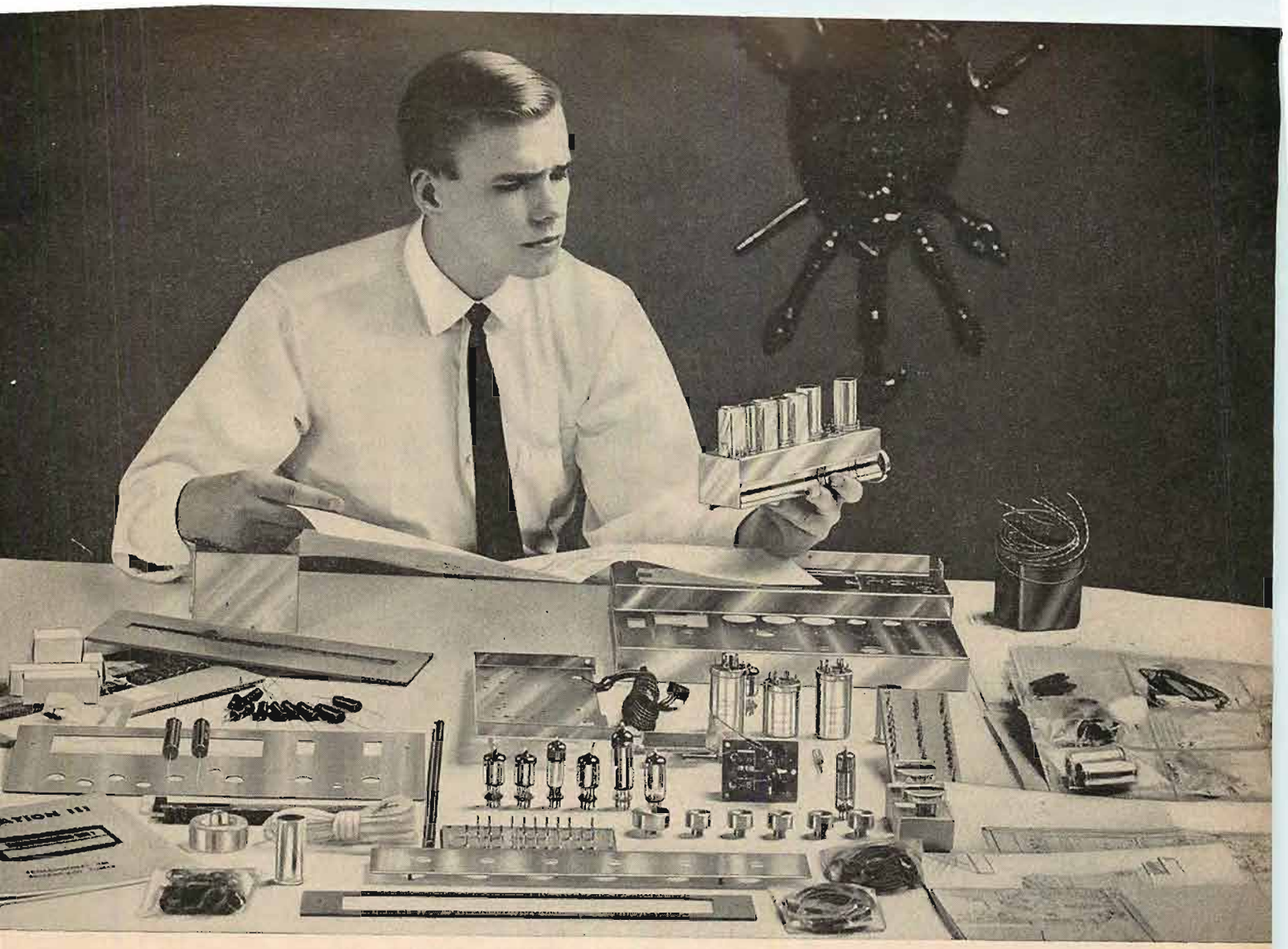


	C1	C2	C3	C4	C6	C7	C10	C11	C14	C15	C18	C19	C22	C23
C	.02	.002	.025	.1	.0008	.008	.0016	.016	.0032	.032	.0064	.064	.0125	.125
C♯	"	"	"	"	"	"	"	"	"	"	"	"	"	"
D	.016	"	"	"	"	"	"	"	"	"	"	"	"	"
D♯	"	"	"	"	"	"	"	"	"	"	"	"	"	"
E	.0125	.0016	.02	.08	.00064	.0064	.00125	.0125	.0025	.025	.005	.05	.01	.1
F	"	"	"	"	"	"	"	"	"	"	"	"	"	"
F♯	.01	"	"	"	"	"	"	"	"	"	"	"	"	"
G	"	"	"	"	"	"	"	"	"	"	"	"	"	"
G♯	.008	.00125	.016	.064	.0005	.005	.001	.01	.002	.02	.004	.04	.008	.08
A	"	"	"	"	"	"	"	"	"	"	"	"	"	"
A♯	.0064	"	"	"	"	"	"	"	"	"	"	"	"	"
B	"	"	"	"	"	"	"	"	"	"	"	"	"	"

*= 200 v. d. c. w.

Fig. 16. Schematic of Kinsman tone generator. Each printed circuit contains two adjacent notes.

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Can You Afford 15 Hours to Build The World's Best FM/Multiplex Tuner?

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

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

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

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

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The Citation III FM tuner—kit, $149.95; wired, $229.95. The Citation III MA multiplex adapter—factory wired only, $79.95. The Citation III X integrated multiplex tuner — kit, $219.95, factory wired, $299.95. All prices slightly higher in the West.

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HERMAN BURSTEIN*

(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)

Silicon Rectifier

Q. I have a stereo tape recorder and plan to build another power amplifier. The circuit calls for a power transformer with 393 volts at 200 mils in the high voltage section. I have another transformer which delivers 355 volts at the required current. If I can substitute a silicon rectifier for the rectifier tube, a GZ34, can I get the required voltage?

A. You may pick up as much as 30 volts by substituting a silicon rectifier for a vacuum-tube rectifier. If you are still shy some volts, you might try putting a filament winding of the power transformer, if there is one to spare, in series bucking with the primary. (A direct plug-in replacement for the GZ34 is a 1N2389 silicon rectifier.) Furthermore, any worthwhile amplifier circuit should operate well at voltages within 10 to 15 per cent of design value. Therefore, if your ultimate voltage still is somewhat less than 393, the amplifier's performance should not be seriously affected.

Hysteresis Motor

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

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

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

Magic Eye vs. VU Meter

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

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

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

In view of the fact that you are planning to buy the *** tape recorder, the desirability of a VU meter is lessened by the fact that this tape machine has separate record and playback heads. This permits you to monitor the tape while recording, thereby guarding against excessive distortion, which after all is the main purpose of the record-level indicator.

Wow and Flutter

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

A. Wow is a slow variation in speed, audible as a quavering effect or one that causes a steady note, such as produced by a piano, to go "sour." Flutter is a rapid variation in speed, which imparts a grainy, buzzy, or coarse quality to a sound. In any tape machine deserving of the term high fidelity, wow and flutter should be undetectable to any ear except perhaps the extremely sensitive one. To judge whether there is appreciable flutter, and also wow, record and play back a steady tone of about 3000 cps, for example from a test record or, better yet, an audio oscillator; or play back a test tape designed for this purpose. In playback, if the recording is made at moderate level (somewhat below maximum recording level), the tone should sound steady, pure, and sweet rather than pulsating, grainy, or coarse.

Cable Length

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

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

Loss of One Channel

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

A. Your difficulty may be a faulty solder connection. When the tape deck has been in operation for a while, the increase in temperature may cause enough expansion at the poor connection so that the signal gets through. When the machine cools, the connection opens up again. Accordingly, you might try reconditioning the solder connections involving the leads to the record-playback head. Unless you are on familiar grounds here, you bring the tape recorder to an service dealer. There is also the head being at fault, be substitut

* 280 Twin Lane E., Wantagh, N. Y.

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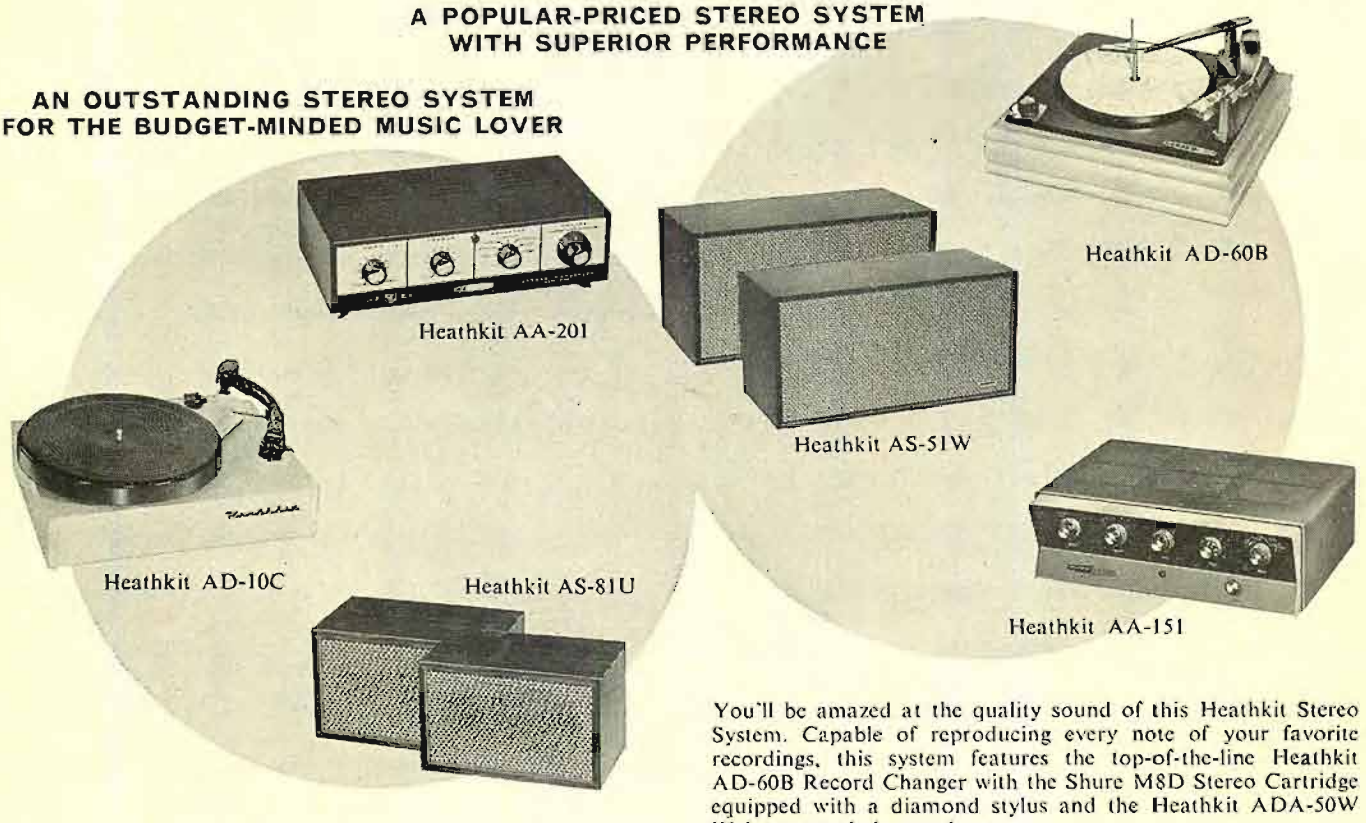
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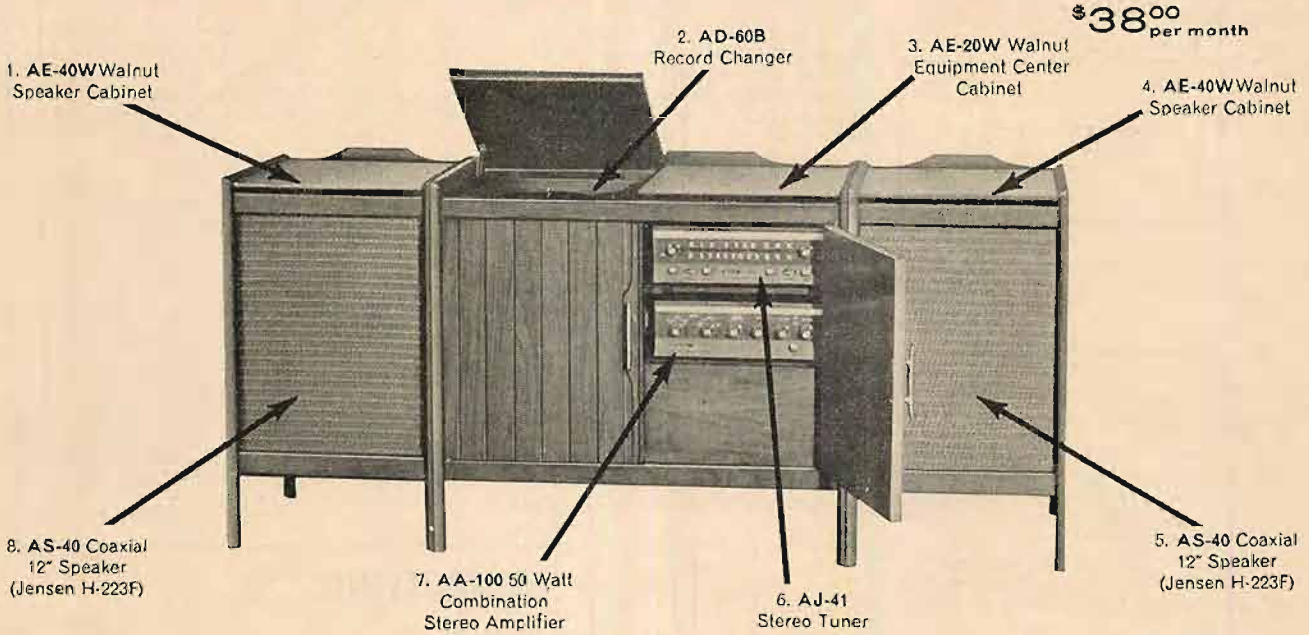
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NORMAN H. CROWHURST

Answers to Last Month's Teasers

Answer B-1. This question frequently crops up. In a correctly designed filter of this type, at crossover frequency there is 90 deg. transfer delay in the low-pass section and 90 deg. transfer phase advance in the high-pass section. This means the two signals at the outputs are precisely out of phase. At frequencies adjoining crossover, the phase transfer angle of each section changes, but retains the total of 180 deg. at all frequencies (theoretically from zero to infinity).

It is usually argued that, for the high and low frequencies to produce their outputs in correct phase relationship, both units should be in phase; but this would

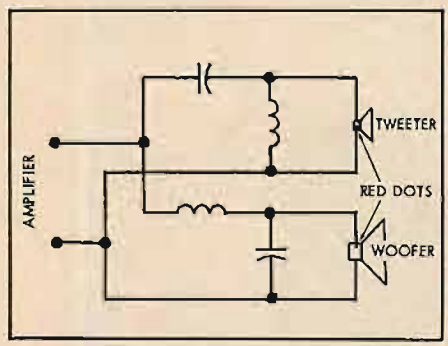


Fig. B-1. Correct connections.

result in out-of-phase operation in the important frequency regions where both units are contributing essentially equal acoustic power. To cover the crossover range of frequencies correctly, the units should be connected out of phase, according to the test, so the acoustic outputs are in phase over this range.

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

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

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

This Month's Questions

Question C-1. A high-fidelity enthusiast had built an amplifier from a kit. When a friend noted that the output transformer did not look husky enough to be a quality job, our enthusiast decided to try a "better" one. Getting a larger unit, with the same ratio, impedance ratings, frequency response, and so on, he installed it, hoping his quality would be demonstrably worth the effort; instead it was inferior to the original transformer. For the record, the output stage used push-pull, with the tubes connected as triodes, overbiased so as to work in Class AB_1. What could be wrong with the transformer, assuming it tested out well according to specs?

Question C-2. Comparisons were being made between two systems, one rated to have an output of 15 watts, the other 60 watts. Each was operated with the loudspeaker system recommended for it. First test used a piece of program using a jazz combo, and the 60-watt system definitely had more power and punch than the 15-watt system. The next test used a symphonic recording, and seemed to reverse the situation: the 60-watt system folded up long before the 15-watt system sounded too bad; a little distortion might be detected in the 15-watt system, but not the complete inability to handle evidenced by the 60-watt system. Why the difference, with different program materials?

Question C-3. The relationship between frequency response and observed (audible) performance is often brought in question. Readers write in about it. Articles are written about it. Both report apparently contradictory experiences. On the other hand, many report that an amplifier with lots of feedback and a response from subaudible to ultrasonic frequencies (even up into the megacycle range) is much cleaner sounding than one with less pretentious performance. On the other hand, others make precisley similar comparisons and come to the opposite conclusion: extended range, beyond audible limits, "costs" in other respects; these claimants argue that the best amplifier is one designed to deliver what you hear, and not to service bats and other creatures. Which of these views is right—is one influenced by "wishful thinking"—or can they be reconciled?

Reader Answers

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

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

For response down to 50 cps with a 250k load, total circuit capacitance would have to be 20 times as great as with a 5 megohm load. It would have to be 12,800 pf. The difference between 12,800 pf and 640 pf is .01260 μf. Therefore we can achieve good bass response by wiring a .012 μf capacitor in parallel with the output terminals of the pickup.

At the same time this capacitor would cause 26 db over-all reduction in output of the pickup. The question, then, is whether the amplifier has sufficient gain in view of the signal we can expect from the pickup. Typically, a ceramic pickup can produce between 1 and 3 volts on peaks. A 26-db reduction would yield peak values between 50 and 150 mv. Many amplifiers have sufficient sensitivity to be driven to full or ample output by such a signal.

If the amplifier lacks such sensitivity, or if the pickup produces less than 1 volt on peaks, we could use a 500k load control or perhaps even a 1 megohm control without encountering hum. This would entail only a 20 db or 14 db reduction in signal, which for most ceramic pickups and most amplifiers should be enough to drive the amplifier to full output. For a 500k load the capacitor across the pickup should be about .006 μf; for a megohm load it should be about .0025 μf. *H. B.*

AUDIOCLINIC

(*from page 4*)

pattern in each direction. This arrangement gave the dipole the ability to hear most signals in the vicinity of the antenna. The yagi, on the other hand, is capable of receiving signals in only one direction over an angle of perhaps 30 deg., the exact angle depending upon the number of elements used.

Because of this characteristic of the yagi and all other parasitic arrays, means must be provided which can change the direction to which the yagi points if coverage is to be complete. The rotator does this and lets you know from where you can expect to hear stations with a given setting.

The actual operation of this kind of antenna depends upon the phase relationships of the signals on each element. The reflector is intended to reflect signals from the rear of the yagi back into the dipole while the director focuses the signals from the front of the array into the dipole. Only one reflector is usually employed; additional reflectors do not add significantly to the performance of the arrays. Doubling the number of directors will increase the strength of a received signal by 3 db. An 8-element yagi can be expected to provide an apparent gain of between 10 and 13 db. Sometimes, rather than doubling the number of elements in a single array, two or more arrays are stacked on the same mast and connected to a common feed line. This also will increase the performance. Of course, as the performance is improved, the sharpness of the pickup pattern is also increased. An 8-element array will have a pickup pattern of 30 deg. between points at which the signal is down 3 db.

Books can and have been written on this subject. Space does not permit a fuller discussion of the working of the array and its application not only to receivers but to transmitters. I do hope, however, that this gives you some idea of the yagi, and can show you how to improve your FM reception. Do not consider using such a device to improve AM reception. You would be rotating a boom hundreds of feet in length. *Æ*

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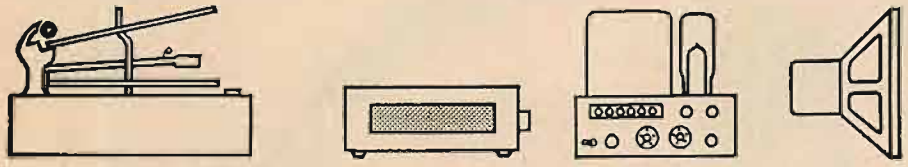


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EQUIPMENT PROFILE



FISHER STRATAKITS MODELS KX-200 and KM-60

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

Each section of the KX-200 consists of an ECC83/12AX7 as the preamp stage with feedback equalization for both phono and tape, followed by the selector switch, a high-cut filter, a tone-control amplifier using another ECC83, the loudness-volume control, another ECC83 as amplifier and direct-coupled phase splitter, and a pair of 7591's as the output stage. The output tubes are operated with fixed bias, and both bias and balance are adjustable, with a switchable meter being used to indicate the correct settings. Controls include a tape/phono switch to change equalization in the low-level inputs which are marked MAG 1 and MAG 2, tape monitor switch, loudness contour switch, dimension control which ranges from mono, wherein both channels are coupled together, to stereo where they are completely separate, balance control, and the usual selector, mode, separate bass and treble tone controls, and the volume control. In addition, there is a center speaker switch which has five positions—off, low, medium, high, and maximum. This switch introduces more or less resistance into the center speaker circuit which is fed from the common tap of the left channel and the 16-ohm tap of the right channel, with the 4-ohm tap of both channels being grounded to the chassis. The meter switch and the bias and balance controls for the output stage are located on the top of the chassis.

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

IM distortion measured 1 per cent at 36 watts, and harmonic distortion was under 0.5 per cent at the same output. Channel separation measured 52 db at 1000 cps, 28 at 10,000. A phono or tape-head input of 3.4 mv produced full output, with 320 mv being required at the high-level inputs. With the volume control set to give rated output at an input of 6 mv at the phono input, hum and noise measured 69 db down, and with the volume control turned to minimum, the hum and noise measured 96 db down. The tone control range was measured as +10 and −15 at 50 cps, and +15 and −16 at 10,000, while the high filter produced a cut of 12 db at 10,000 cps.

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

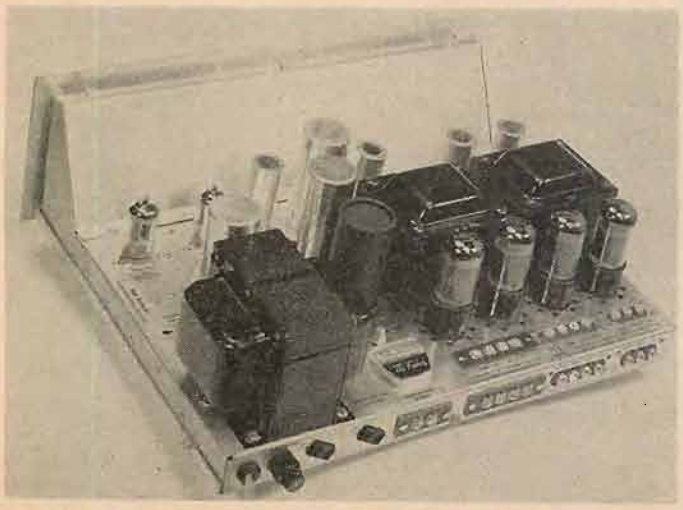
C-24

The KM-60 Tuner Kit

Immediately following the construction of the amplifier, we turned to the tuner. This unit, which is very similar to the factory-built 50-B tuner, consists of a cascode r.f. stage, employing an ECC88/6DJ8, a mixer and oscillator using the two sections of an ECC-85/6AQ8, with two 6AU6 i.f. amplifier stages and two 6AU6 limiters, feeding a wide-band ratio detector. A meter in the grid circuit of the second limiter serves as a tuning indicator for normal use, while chassis-mounted switch permits connecting the meter to the ratio detector circuit for use in initial alignment. A panel switch feeds the de-emphasized mono signal to the two grids of an ECC83/12AX7 as anode followers feeding the output jacks.

The multiplex unit comprises a 12AT7 signal and pilot amplifier, with the latter's output synchronizing a 12AX7 multivibrator at 38 kc to provide the subcarrier to two diode bridge circuits. Their outputs are fed to the two grids of a 12AT7 where separation compensation is added, along with the de-emphasis for the two stereo outputs, which are then fed to the output 12AX7 anode followers. The presence of the 19-kc pilot signal furnishes a bias of some 6 volts to the grid of an EM84A, which closes the pattern and indicates that the program is stereo, whereupon the user switches to stereo. Another position of the stereo-mono (and power) switch introduces a capacitor between the two multiplex outputs to reduce noise. Both the front end and the multiplex sections are factory built and aligned, so the final alignment of the unit is quite simple and can be accomplished without any instruments in less then ten minutes. After using the recommended alignment, we tried it with a sweep oscillator and 'scope, with no apparent change at all.

As to sensitivity—the KM-60 has all that is necessary, 1.8 microvolts by IHFM measurment standards. We found that with only about three inches of wire connected to the antenna terminals we could get every one of the important stations in the New York area, with limiting on most of them. It is a fine performer throughout—listening quality excellent, stereo performance excellent, hum and noise satisfactorily low. One feature we like par-

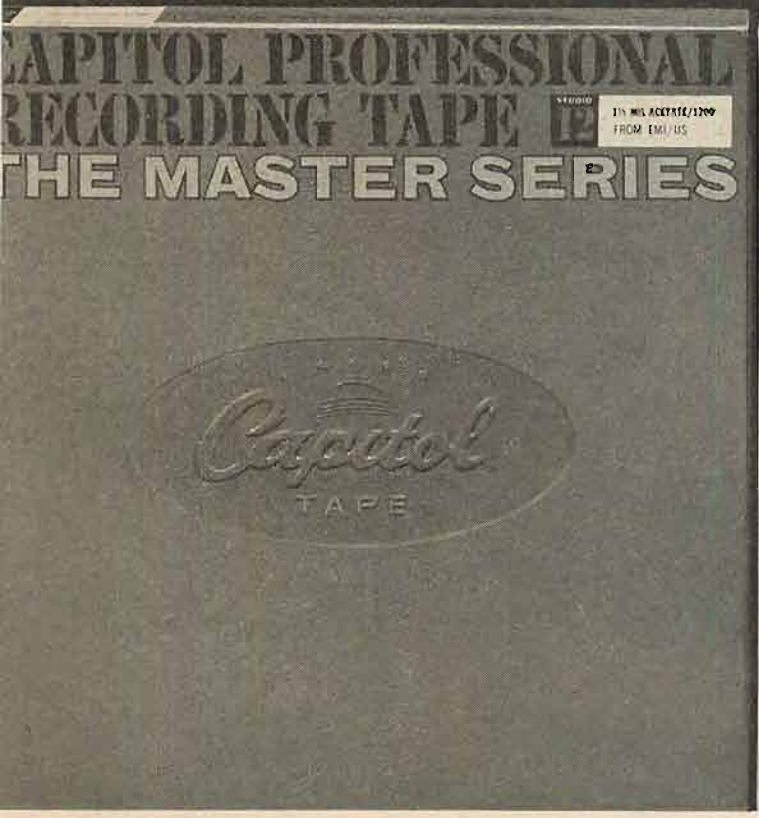


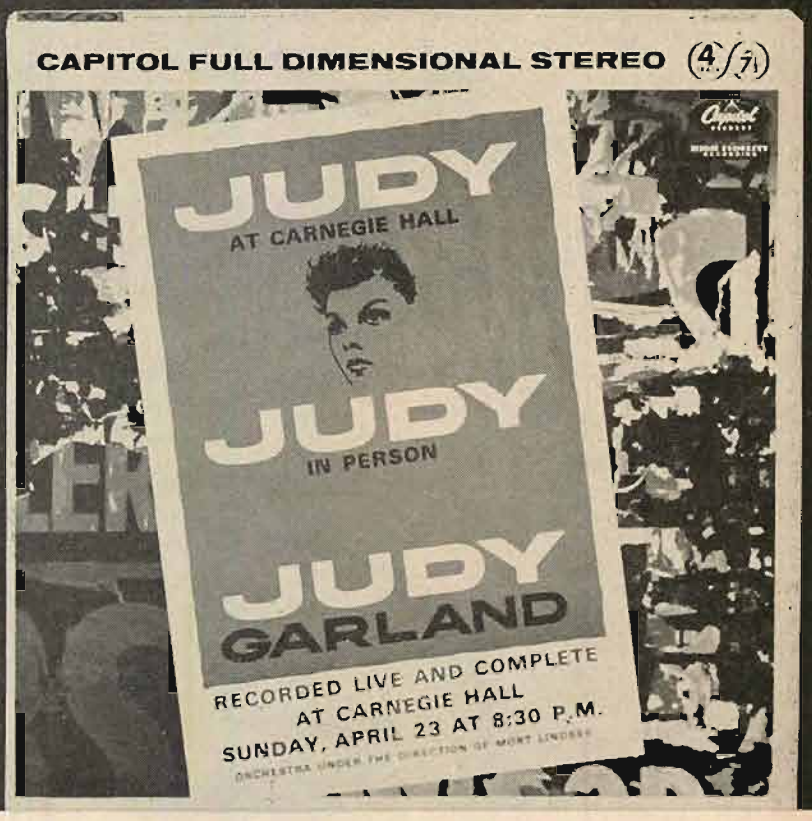


Chassis view of the two completed Fisher Stratakits—Fig. 1 (left) is the KX-200 amplifier-preamp, and Fig. 2 (right) is the KM-60 tuner.

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Fig. 3. Panel view of the KM-60 FM-stereo tuner mounted in the accessory walnut cabinet.

ticularly is the stereo indicator which lights up whenever one turns to a stereo station.

Construction

Construction of both units is simple and quite fast—13 hours for the amplifier and just under 8 for the tuner, and both worked right off the bat. In both kits, the instructions are broken down into stages, each apparently designed to take about half an hour. The parts for each stage are packaged in separate polyethylene bags, each with the contents listed on a card enclosed in the bag. Wire lengths are given, and the lengths of resistor and capacitor leads down to the nearest ⅛ in. The introductory treatise in the instructions covers soldering thoroughly and should make an expert of practically anybody. In the amplifier kit especially, the over-all tone of the instructions is light and amusing. Phrases that brought out smiles were encountered regularly, such as, " . . . if you have any parts left over you goofed! Go back and check," After stage 4 of the amplifier, the builder is cautioned "to take a break" so as to avoid carelessness caused by getting tired. There are special instructions on how to handle shielded cable, silicon diodes, and mistakes.

Much of the drudgery is avoided by the factory mounting of sockets, transformers, tie points, and similar parts, not to mention the tuner front end and the MX units. In the amplifier, all controls and switches are properly mounted on the front plate so as to eliminate the possibility of selecting the wrong part—which could happen easily to an inexperienced builder.

On the whole, we found these kits to be beautifully packaged and "instructed," and easy to build, *and* the performance is impeccable. So now, you, too, can build a Fisher.

HEATHKIT MODEL IO-21 OSCILLOSCOPE

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

In the oscilloscope, the "writing" element is actually a beam of electrons which has—to all intents and purposes—no inertia whatever. For example, on the face of a 21-in. picture tube, the beam moves about 20 in. for each scan, and there are 15,750 scans per second, so the beam is actually moving across the screen at around 18,200 miles per hour. On many laboratory-model 'scopes, the beam can travel some 200 times that fast. In contrast, the beam of a typical 3-in. 'scope traveling over the limits of the 2-in. reticule at 10,000 cps needs to travel only about 2300 miles per hour.

Needless to say, the requirements of the audiofan do not warrant the expense of 'scopes capable of handling 100 mc, and it is true that some of the finest lab 'scopes cost as much or more than a small automobile. However, within the limits of its frequency range, any 'scope is equally accurate in its presentation of waveform data. The Heathkit IO-21 'scope is a small, compact, and lightweight instrument priced well within the budget of any earnest experimenter, and capable of handling frequencies up to 200,000 cps. It measures 9½-in. high, 6½-in. wide, and 10-in. deep, and weighs only 12 pounds—quite a contrast to an elderly 5-in. model we have which weighs 53 lbs. The IO-21 builds in around 7 hours, and is a fine performer after its completion.



Fig. 4. New Heathkit IO-21 oscilloscope.

Since the requirements of audio and most general radio servicing are not as severe as

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those for microwave work, for example, it is possible to reduce the cost appreciably by resorting to a simplified design without eliminating any needed function. In the IO-21, there is no focus control on the panel —focus and astigmatism are adjusted by internal controls which need no touching up throughout the entire range of the instrument. There is no intensity control—intensity is set by the original design. There is no synchronizing control—sync is fed to the multivibrator time-base generator from the vertical amplifier automatically. The two deflection amplifiers are identical, consisting of a cathode follower, gain control, and a driver direct coupled to the push-pull output stage.

Performance

The horizontal sweep is calibrated on the front panel in four ranges from 20 cps to 100,000 cps, and will actually sync from 10 to 230 cps on the lowest range, 90 to 2500 on the second, 1600 to 27,000 on the third, and from about 16,000 to 125,000 cps on the top range. The horizontal expansion is great enough that with a six-cycle pattern on the screen, the pattern can be spread out to permit a full-screen sine-wave of any one single cycle of the six. In the vertical direction, the pattern can be moved up or down enough to view the top or bottom of a 5-volt input signal when the gain control is adjusted for a full-screen pattern for an input of 0.5 volts. This is the sort of pattern mobility that is usually encountered on only the most flexible 'scopes.

Specifications call for an input sensitivity of 0.25 volts/inch, but the actual measured value was 0.18 volts/inch, which is considerably above the claimed figure. One other desirable feature is the blanking which eliminates the unwanted return traces which so often become objectionable at high sweep frequencies.

The 3-in. cathode ray tube is protected by a heavy Plexiglas screen and a green reticule graduated in ¼-in. squares over an entire pattern of a 2-in. square. Terminals are available on the back for direct connection to the deflection plates for observations above the frequency range of the internal amplifiers and at high signal voltages. A switch selects either the terminals or the internal amplifier.

This is the first 'scope we have observed in some time which had all the features required for audio work without undue complication. Previous low-priced 'scopes generally had limitations in over-all performance which forced the user to compromise. The Heath IO-21 does not seem to have any limitations for which compromises must be made in any work that the audio engineer, serviceman, or experimenter needs to do.

OMEGA TRANSISTORIZED STEREO AMPLIFIER, MODEL 1600

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

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

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

The Omega 1600 is the first transistor amplifier we have tested which delivered 30 watts IHFM (25 watts rms) per channel. The frequency response was within 0.5 db from 30 cps to 40,000 cps and ±1.5 db from 10 cps to 55,000 cps. For some unaccountable reason harmonic distortion did not meet specifications (less than 1 per cent) at the extreme low and high frequencies although IM distortion was within specifications. In all other areas the 1600 performed extremely well. In all, a rather satisfying early production sample. C-27

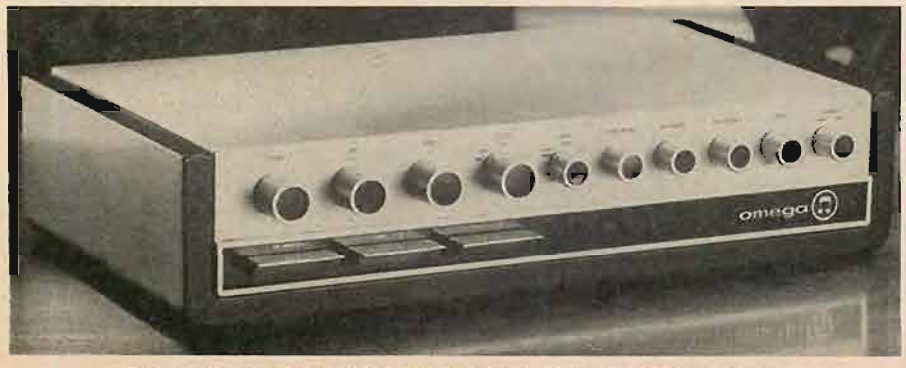


Fig. 5. Omega's Model 1600 transistorized amplifier-preamp.

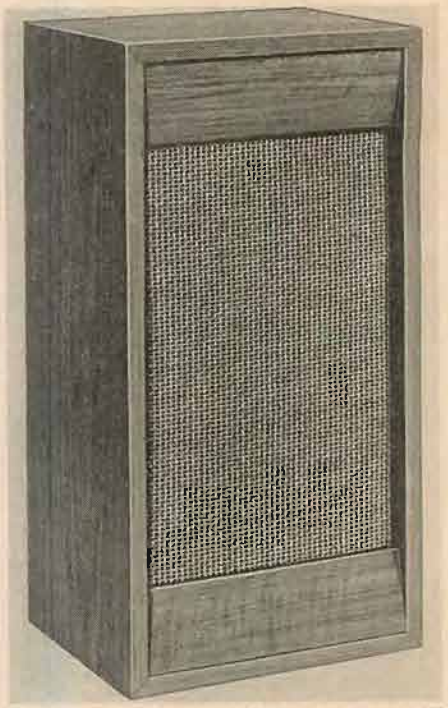


Fig. 6. H. H. Scott speaker system, Model S-3.

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

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

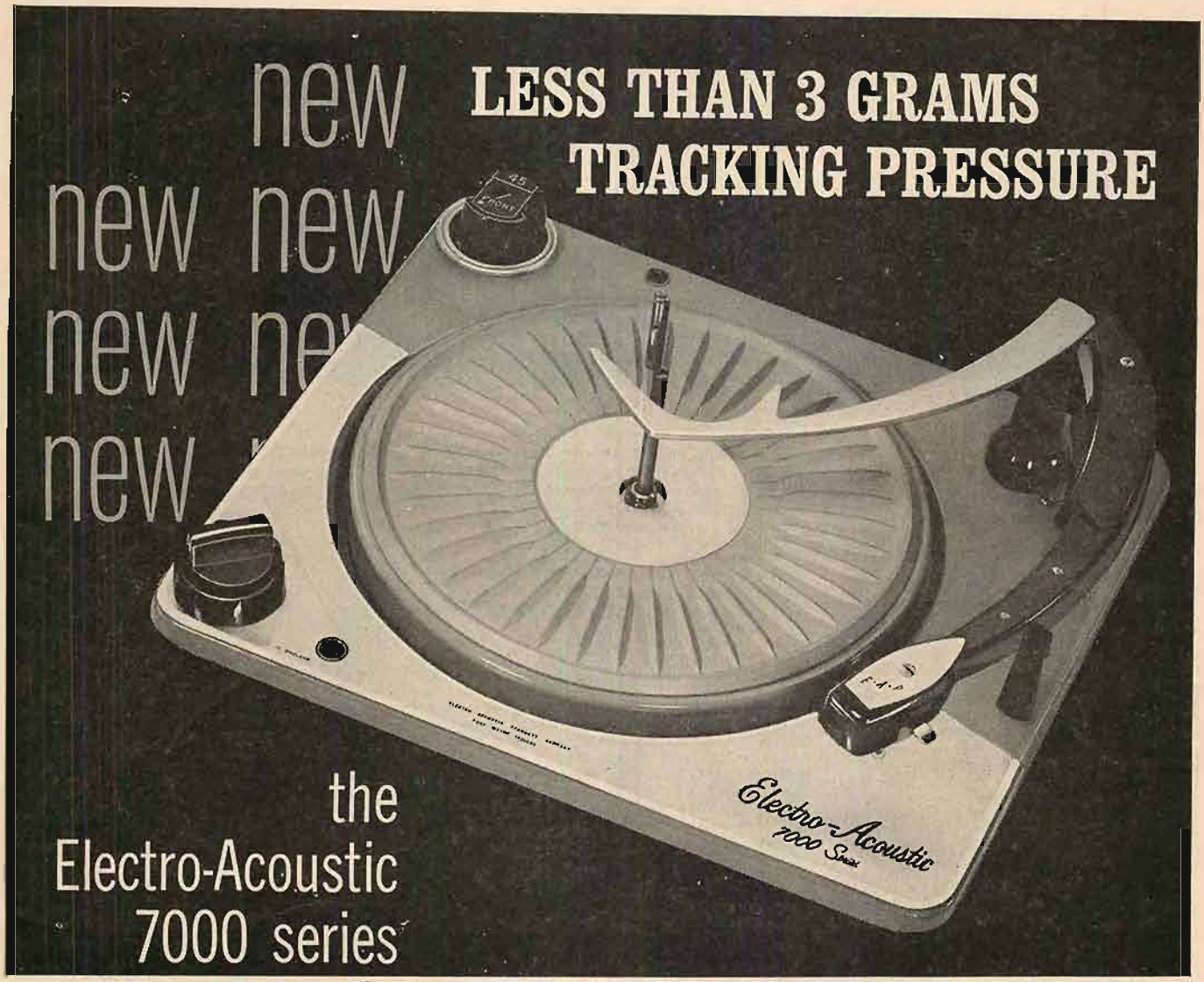
The S-3 is a three-way speaker system which utilizes "air loading" to improve low-frequency response. In addition, the crossover network is used to help "flatten" the mid-range response. In reality, the crossover network is used in the S-3 in a manner similar to the way a tone control is used to compensate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

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

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

More specifically, the H. H. Scott Model S-3 speaker system reproduces music with as little coloration as any bookshelf speaker system we have heard. Both extremes of the audible frequency spectrum are solid while the mid-range has just that touch of brightness that we personally enjoy. C-28

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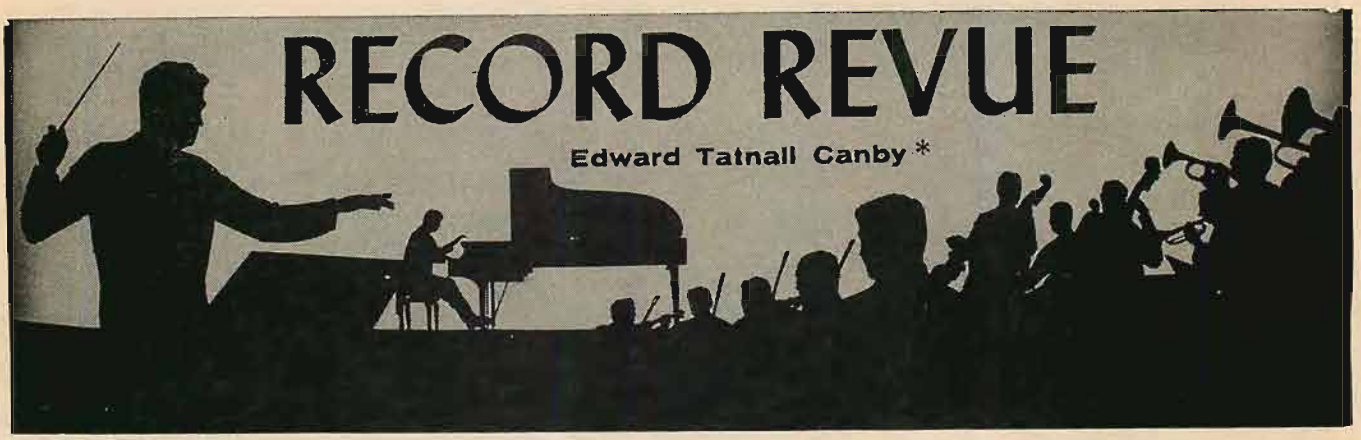
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RECORD REVUE

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VOICES

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

RCA Victor LSC 2570 stereo

This memorial to the Scandinavian tenor who died in 1960 is a collection out of his later recordings (in stereo), after a 25-year career in which the superb vocal technique scarcely altered, nor did the voice grow old. Bjoerling was a mild, almost placid tenor compared to the fiery-voiced Caruso or the brassy Lauritz Melchior in his big days. But Bjoerling did have what is now virtually non-existent, a real, old-fashioned perfection of vocal production, absolutely never forced and, thus, never forcing the voice itself into overwork. Paradoxically, his finest milieu was in the Italian opera area, where the impact of a perfect technique and high musicianship easily outbalanced the mildness of temperament that could show up to his detriment in the heftier Germanic roles.

Eileen Farrell in Verdi Arias. Columbia Symphony, Rudolph.

Columbia MS 6254 stereo

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

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

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

Angel 35963 stereo

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

The styles vary pretty widely. We begin with Henry Purcell, in English (practically faultless), then go on to a Haydn setting (in German) of a Scots air, *All Through the Night* and a brace of Beethoven's similar arrangements of Irish tunes (in English) with an interlude by the "London" Bach, Johann Christian, sung in Italian. Side Two moves from Schubert through Dvorak, Tchaikowsky, Saint-Saëns and Fauré—a pretty kettle of musical fish and any other than this superbly musical team would manage to make hash of it. Good musicianship pays; here we have three of its top practitioners.

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

Deutsche Gramm. 138 641 stereo

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

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

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

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

Vanguard VSD 2099 stereo

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

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

Moussorgsky: Songs and Dances of Death; The Nursery, etc. Netania Davrath, sopr., Erik Werba, pf.

Vanguard VRS 1068 (mono)

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

Devrath's voice is light, rather white in tone. In the delightful "Nursery Suite," a set of songs in which a child speaks of his own life in child-terms, she is superb, taking the child's part with animation and musical finesse. But in the stark, terrifying "Songs and Dances of Death," Devrath is out of her element. The drama is missing. If you want to hear these songs in all their chill fearsomeness (and their human appeal) try to dig up Jennie Tourel's old Columbia recording, on an early LP. Next to that, this one is almost insipid—though musically accurate and beautiful in the singing tone.

Liszt: "Dante" Symphony. Budapest Philharmonic, Budapest Radio Choir, Lehel.

Westminster WST 14152 stereo

The revived Westminister label is issuing an interesting series of recordings out of Budapest, where the musical tradition remains so very strong that to this day, and on all sides of the political front, Hungarian-trained musicians are the most brilliant and solid we can find anywhere. Liszt wasn't exactly a Hungarian composer, but in his day he did produce what passed for Hungarian music (even if it did turn out mostly to stem from gypsy cafe material). That's enough for present-day Hungarians, who perform him as a national hero.

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

INSTRUMENTS

Brahms: Symphony #2. Pittsburgh Symphony, Steinberg.

Command Classics CC 11002SD stereo

Haven't enjoyed this old symphony so much since . . . well, since I played the 1940 Mengelberg Telefunken recording recently released. (See above). And the stereo microphoning on this new label is out of this world, a marvelous example of what I might

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A DATE WITH EDDIE CANTOR, Songs, Stories and Anecdotes from his Carnegie Hall One Man Show
Makin' Whoopie • If You Knew Susie • Ida • Ma, He's Making Eyes At Me • There's No Business Like Show Business • Dinah • Is It True What They Say About Dixie? • Margie • Josephine Please Don't Lean On The Bell • and others
AFLP 702



NICKEL MUSIC, The Sound of the Nickelodeons at Paul Eakins' Gay Nineties Village
King Cotton • Dixie • Patriotic Medley • Georgia Camp Meeting • Hands Across The Sea • The Jolly Coppersmith • The Irish Washerwoman • Battle Hymn Of The Republic • My Wild Irish Rose • March Medley • Carry Me Back To Old Virginny • Yankee Doodle • Ta Ra Ra Boom De Ay • Over The Waves
AFLP 1960 • AFSD 5960



SOUND EFFECTS, Volume 3
Teletype Machines • Facsimile Wirephoto Machines • Cuckoo Clocks • Grandfather Clock • Clock Ticking (time-bomb effect) • Army Pistol Range • Heavy Artillery • 'Vulcan' Aircraft Machine Gun • M48 Medium Tank • Close Order Drill • Police Car Passing Thru Traffic • Pedestrians In City Street • Thunder And Rain • Rain On Pavement • N. Y. Subway • Model T Ford Starting, Idling, Passing • Electronic Effects • many others
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AFLP 1946 • AFSD 5946



BRASIL, BOSSA NOVA, SAMBAS, MARCHAS
O Apito No Samba • Mulata Assanhada • Poema Do Adeus • Covarde • Arrasta A Sandalia • Marcha: Mundo De Zinco • Eu Chorarei Amanha • Lata D'Agua • Nao Me Diga Adeus • Chora Tua Tristeza • Implorar • O Amor E A Rosa • Recordar • Marcha: Madeira De Lei • E Com Esse Que Eu Vou
AFLP 1954 • AFSD 5954



CARNAVAL DO BRASIL, MARCHAS, FREVOS, SAMBAS
Tumba Le Le • Levanta Mangueira • Pra Seu Governo, Recordar • Na Base Do Amor • Se Eu Errei, Me Da Um Dinheiro Ai • Indio Quer Apito • A Lua E Dos Namorados, Evocacao • Vassourinha, Madalena Vai Casar • Cacareco E O Maior, Piada De Salao • Maria Escandalosa • Paie, Quem Me Ve Sorrir • Nao Me Diga Adeus • General Da Banda, Qual E O Po • Vai Ver Que E • and others
AFLP 1953 • AFSD 5953

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

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

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

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

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

If you want to hear the marvels inside a Brahms symphony, the multitude of countermelodies, the color touches, the play of the orchestral choirs, this semi-close-up "curtain of sound" is "the most." I'm glad Command has already sold 50,000 of this disc. You'd better try one, too.

War-Time History

Brahms: Symphony No. 2. Concertgebouw Orch., Mengelberg. (Recorded April 9, 1940).

Telefunken TH 97005

Tchaikowsky: Symphony No. 6 ("Pathétigue"). (Recorded April 22, 1941). Concertgebouw Orch., Mengelberg.

Telefunken TH 97002

Historic recordings with a vengeance, these. How strange is musical history when it is lined up against the larger world in which it exists! I thought, somehow, that the dates above might be especially significant. I rushed to my "Rise and Fall" (*"Rise and Fall of the Third Reich,"* by Wm. L. Shirer) and lo—the great Willem Mengelberg, one of the finest conductors of the early century, recorded this Brahms with his Dutch orchestra on the very day of the invasion of Norway by the Germans and the sudden overpowering of its small neighbor-nation, Denmark.

The Norwegians fought for awhile, but the Danes never even had a chance to try. And there, only a few miles away on that day, was Brahms, serenely lively, played in the great tradition of high Romanticism in which the symphony was composed, led by a man who had taken over this orchestra before the turn of the century. Astonishing—and what a lovely, warm, plastic, genuine performance it is, too! To Mendelberg, Brahms was still young and new. Good-quality, old-style 78's. You can hear the swish-swish faintly.

It was only a month later that the larger invasion which completed the conquest of Europe overwhelmed Holland itself, in a mere five days of terror.

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

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

Is there anything Hitlerian about it? Well, the Dutch string section is pitifully weak, a handful of fiddlers, placed close to the microphones. War-time attrition. Much more significant, the technical quality of the sound is startlingly *improved* over that of the Dutch recording of a year earlier. Fabulous! And sinister—for this must have been the sudden influence of German technology. At such a time! Well, such is life, and Telefunken (via London) is aesthetically 100 per cent right in bringing us again these outstanding recordings, out of a troubled history.



Check this weekly schedule . . . MONDAY: Vocal group (Omnidirectional), TUESDAY: Soloist (Cardioid), WEDNESDAY: Trumpet . . . Close-up (Overload protection switch), THURSDAY: Duet (Figure 8), FRIDAY: Newscaster (Voice switch). Now, all these day-to-day studio problems can be solved with ONE NEUMANN U-67 MICROPHONE! Switch controlled directional characteristics (all patterns), low frequency response, and sensitivity, are the three separate compensation possibilities provided by the U-67 . . . the only microphone with such unique versatility. Remember the thrill, the first time you tested the famous U-47? The U-67 will thrill you anew, setting new standards with its completely natural and undistorted sound even when inches away from the sound source. Incidentally . . . the one situation in our group above, for which we DO NOT recommend the U-67, is the SATURDAY concert hall assignment. The M49b with remote controlled directional patterns is better for this particular purpose. Write us about your special problem. The U-67 can probably solve it . . . or we will forward details on the NEUMANN microphone most suited for your needs. Address inquiries to Dept. M.

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Instruments of the Orchestra. Commentary by Yehudi Menuhin. 50-page ill. booklet.
Capitol HBZ 21002 (2) mono

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

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

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

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

Poulenc: Concerto for Organ and Strings. Stravinsky: Jeu de Cartes. Boston Symphony, Munch.
RCA Victor LSC 2567 stereo

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

The Stravinsky "Card Game" is also in the high neo-classical tradition (1936), Bach-like in its steady, pulsing rhythmic figures, ingratiating to the ears of today as though already out of a classical period in the past—which it is, to be sure. Music now is made of sterner stuff, in the atomic age.

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

Ravel: Daphnis and Chloe (Suite No. 2): Alborada del Gracioso; Le Tombeau de Couperin; Valses Nobles et Sentimentales. L'Orch. de la Suisse Romande, Ansermet.
London CS 6210 stereo

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

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



WHAT CARTRIDGE SHOULD YOU USE IN YOUR RECORD CHANGER?

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

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

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

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

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

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

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

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

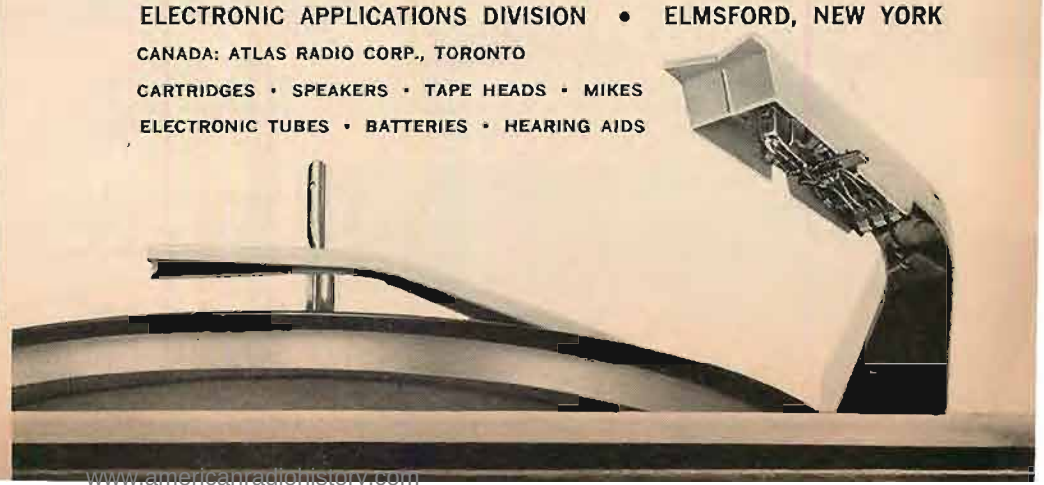
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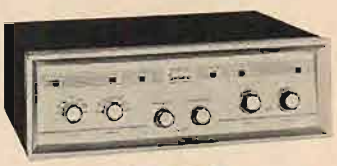
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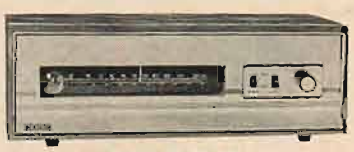
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Eighteenth Century Flute Duets. Julius Baker, Jean-Pierre Rampal.
Washington WR 442 (mono)

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

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

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

Aristid Von Wurtzler, Harpist.
ASCO A112 stereo
(Am. Stereophonic Corp.)

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

Why? Well, nobody can deny that M. Von Wurtzler is a fine harp player—he is. But when his Bartók, praised by Kodály himself, turns out here to be no more than a handful of those tiny, half-minute children's pieces of Bartók, that sound much better in their proper piano versions, when an instructional suite by Von W. himself (easy for students) is no more than an insipid and rather amateurish bit of harpish parlor music, when a Von Wurtzler performance of a well-known Handel *Passacaglia* sounds as though Handel were a late-19th century harpist on a small scale—which he was not, when the meat of this disc finally emerges (as might have been expected) as we arrive, come side 2, at the real harpy pieces, all fancy trills and runs, à la Harpo Marx—then . . . well, I'm just not a harp player myself. Nor, probably, are you.

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

DOCUMENTS

Portrait of a Splendid American—A Documentary Tribute to Dr. Tom Dooley.
Columbia ML 5709 (mono)

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

Dr. Dooley, you'll remember, went out to Laos and stirred himself mightily in favor of the native population. He was a kind of dynamic whirlwind Dr. Schweitzer—passionate, where the older Doctor was quietly philosophical, avid for publicity in his cause, where Schweitzer was cautious (and still is), frenetically high-tension in contrast to Schweitzer's enduring calm. And Dooley died of galloping cancer right in the middle of it all, thus quickly ending a career that perhaps was too spectacular for its own good.

Was it? Well, you can judge nicely for yourself, via the abundant quotes from Dr. Dooley's own speeches and broadcasts, on-the-

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scene and on visits home. No question, he was a highly volatile and abundantly endowed young man with an enormously compelling personality. That personality comes through with disturbing vividness here. Congrats to KMOX, St. Louis, which produced this show originally for radio.

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

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

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

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

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

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

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

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

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

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



THE DUAL-1006 CUSTOM

We consider the Dual-1006 CUSTOM to compare more than favorably with any other record player now on the market. So much so that we submitted it for testing to a completely impartial authority. A copy of this report is now available upon request. It contains the facts to be familiar with before considering any purchase of record playing equipment. For your copy write: Dept. C-3,

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

In the early Beethoven, the show is too close-up, too potent, too big, for any normal living room. In the "Appassionata," however—a show-piece if ever there was one—Beethoven takes off with astonishing effect. *That* piece is right at home in the concert hall, and at home with Richter, too.

Yes, he's a great dramatic pianist, a master of big-time performance. But the thoughtful intimacy of the chamber music approach is not his specialty. You'll need to listen to him on records with this in mind.

Spanish Songs and Dances in Motion. Jose Greco and His Dance Company, Orquesta de Conciertos de Madrid, Machado.

Columbia MS 6265 stereo

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

But there's nothing phoney about this presentation. The more intimate dances have the requisite close-up sound of guitars, slapping of thighs, clapping of hands, rattle of castanets and, of course, the brittle rhythms of hard heels and soles on hard wood flooring. Some passages—as is the new style in Spanish recordings—dispense entirely with music for considerable stretches, in favor of sheer rhythm. Very nice.

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

STEAM PLUS

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

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

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

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

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

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

Steam Railroading Under Thundering Skies.

Mobile Fidelity MF 8 stereo

Well, this one has added sound-effects, too. *"Havoc! February, 1961! The full force of angry skies strike Hattiesburg, Mississippi. The stark reality of devastating rain and high water. . ."* Public relations in high gear, if you ask me, and I'll bet the guy who wrote that blurb didn't even own a hi-fi. But there is a real, honest thunderstorm here, just the same, one of those that keep coming back again and again (pre-frontal squall line, I'll insert in my capacity as an amateur meteorologist). The thunder cracks are solid enough and reasonably frequent, the rain just keeps pouring down and down, wetly. In the middle of the record I looked out my window at a perfectly dry city street and jumped perceptibly.

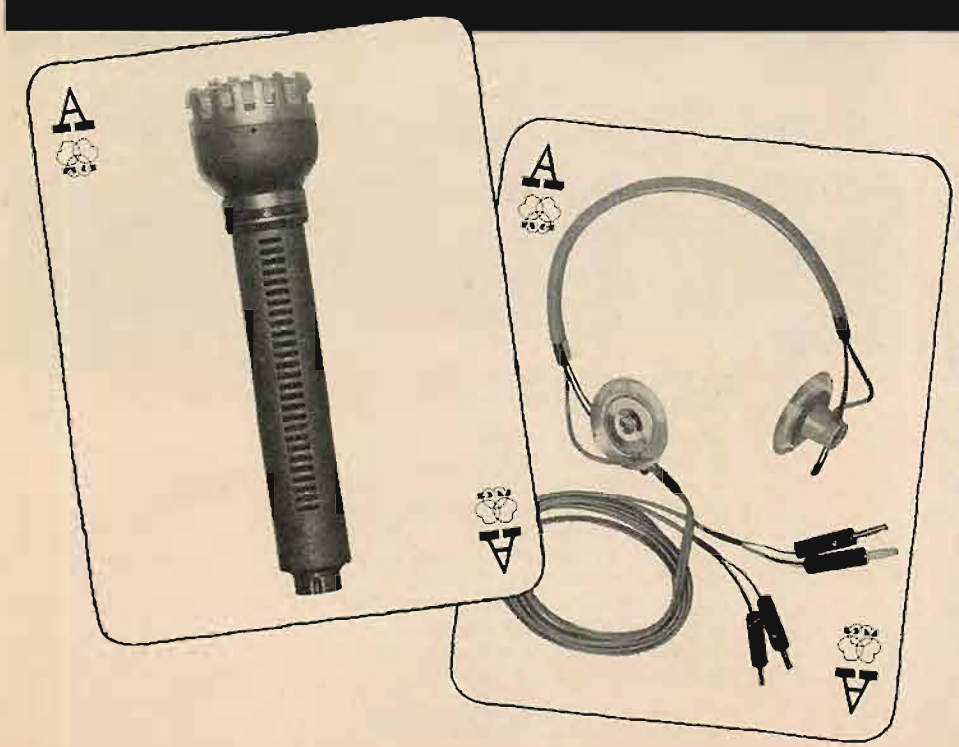
Against this sultry storm there is a train, natch. Old engine No. 300, 2-8-2, comes rumbling along with its train of cars. Sounds just like an old small freight to me, and my only objection is that, as we listen, this train also keeps coming back, over and over again. I can't figure out its schedule.

The darned thing seems to be shuttling busily over a couple of miles of dead-end line, judging from the sound. Whooo, whoooo, who-WOOO echoes the whistle through the stormy Mississippi hills, then choo-choo-choo-CHOO-*CHOO*, rattle-wheeze-bang, and off it goes into the distance—only to turn right around and choo-choo straight back again to us once more. After a few times, this gets to be rather zany. Has the engineer gone mad? Or maybe it's a circular track.

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

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

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MIXER

(*from page 23*)

be doubled except for those items marked with *.

Resistors

½w, 1%
2—100ω
2—3330ω
2—18,000ω
2—100,000ω
2—120,000ω
2—250,000ω
2—267,000ω
2—470,000ω
2—1 Meg
1w, 10%
5—1000ω
4—10,000ω
1—27,000ω
2—47,000ω
1—120,000ω
1—560,000ω
1—820,000ω
1—1 Meg
1w, 10% (picked)
1—22,000ω
1—33,000ω
1—55,000ω
2—56,000ω
1—110,000ω
1—112,000ω
1—224,000ω
1—330,000ω
1—448,000ω
1—550,000ω
variable
5—100,000ω, 2w, pot.
*1—500,000ω, 2w, pot.

Capacitors

1—.005μf, 250v, ceramic
1—.1μf, 250v, ceramic
2—.2μf, 400v, ceramic
4—.5μf, 50v, paper
5—.5μf, 400v, paper
1—2μf, 25v, electrolytic
2—6.25μf, 300v, electrolytic

Switches

4—spst, toggle
*1—spst, rotary
4—spst, lever action
1—1p3t, lever action
1—10 position, rotary

Tubes

2—12AY7
5—12AX7
1—12AU7 (*½ tube/channel*)

Miscellaneous

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

PARTS LIST—*Power Supply*

Resistors

½w, 1%
1—170,000ω
1—260,000ω
½w, 10%
2—1000ω
2—82,000ω
1—180,000ω
1—270,000ω
1—470,000ω
1—1 Meg
power and variable
1—400ω, 10w
1—20,000ω, 2w, pot.

Capacitors

2—.1μf/500v, ceramic
1—8μf/450v, electrolytic
1—80μf/450v, electrolytic
2—150μf/250v, electrolytic

Transformers

1—T_1, 117v isolation (Triad N-51X or equivalent)
1—T_2, plate (Stancor PM-8419 or equivalent)

Tubes and Diodes

1—6AU6
2—12B4
1—5651
4—150 ma, 400v diode
2—100 ma, 600v diode

Miscellaneous

1—spst switch "on-off"
1—fuse, ¾ amp, fast blow
1—fuse, 0.4 amp, slow blow.



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CHARLES A. ROBERTSON*

STEREO

Shorty Rogers: The Fourth Dimension In Sound **Warner Bros. Stereo BS1443**

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

As remixing involves six channels and six recorders, the need for close cooperation between arranger and engineers in preparing the two final tape channels must be fairly evident. In fact, conferences begin well in advance of recording sessions, and each piece is carefully plotted in terms of time and space. Not only does the six-track recording permit complete flexibility of positioning in breadth, but the amount of reverberation can be individually controlled on signals from all sixteen microphones. Soloists or instrumental sections can be placed in depth at will, either during the session or by remixing later through the console.

Even confirmed opponents of artificial reverberation will be intrigued at some of the effects brought off by Workshop engineers, who seldom stoop to anything so simple as applying echo to the entire assemblage at once. Instead, the same instrument may appear to be quite remote or astonishingly close at different points in a single selection. Orchestral sections are isolated in the studio and usually recorded with a minimum of echo. A sound's final trajectory becomes firmly established only during remixing, which is alleged to take three times the number of studio hours normally required. Just how smoothly the engineers work is demonstrated when trombone and reed move forward from far back in the studio on the old Tommy Dorsey favorite *Marie*, terminating with the extreme presence of organlike chords from Ken Shroyer's bass trombone and Bill Hood's baritone sax.

Several playings are required to absorb everything Rogers and his collaborators have up their sleeves, and the experience is less apt to become tiresome than when echo is added in the usual way. One or more instruments always remain fairly stationary in the middle of the stage to provide a focal point for all the action. Some experiments will prove more durable than others, but all are worth noting, especially a "swim" effect used to switch channels with a steady stroke. Serious composers of electronic music have made great progress in inventing synthetic sounds and altering tape speeds, but their lighter minded brethren are being given facilities to take the lead in the conquest of space. Perhaps before long Warner Bros. will let a few of California's bright, young synthesists take a turn at its sixteen-position console.

At present, most seekers of stereo adventure will find Rogers inventive enough, without the help of manufactured sounds, to satisfy their craving. Leading a mobile group of nine studio regulars, he comes up with fresh, swinging ideas to make his debut in super stereo an eventful one. Stereo dialogues are developed between flutists Bud Shank and Paul Horn, drawing responses from Emil Richards, vibes, and bassists Red Mitchell on *Lover*, and *Stompin' At The Savoy*. Dual melody lines are worked out on *You're Just In Love*, and *Baubles, Bangles And Beads*. Latin rhythms go into action on *Kook-A-Ra-Cha Waltz*, with Shelly Manne shaking a tambourine, and the vibrantly exotic *Taboo*. Pete Jolly's piano "swings" about with split-second timing, and the leader's flugelhorn turns up when least expected.

The audio enthusiast who learned about high quality Polymax pressings from Riverside's Fortissimo XK series will welcome news that Warner Bros. also is adopting this superior material. So far, distribution reaches just thirteen western states, and purchasers can detect the genuine article only by looking for two patent marks next to the engraved matrix number near the printed label. Unlike the brightly hued Fortissimo XKs, all copies are colored black and the grooves play from the outside edge. Owners of good equipment should have no trouble spotting the advantages in clarity and presence when comparisons with ordinary pressings are made on their turntables.

Chemists working at Research Craft Corporation discovered Polymax, which is prepared as an additive to harden and convert pure vinyl resin into an improved medium for preserving delicate sound impressions, and Stereo Workshop pressings were shipped for review from the Los Angeles plant. Ewing Nunn's Audiophile is another label which played a part in the development of the new compound, and some collectors may have sampled early pressings without knowing it. Since the last Fortissimo XK release, the manufacturer has increased his list of claims and now states that pressings are free from internal stresses, thereby making possible warp free records and a product of less weight. An array of photographs taken by means of polarized light supports this revolutionary claim, and the stress areas in various vinyl mixes are clearly shown. Just to make the proof more binding, an early Polymax pressing containing some signs of stresses pictured along with one of the latest, in which stress appears to be completely vanquished.

Polymax is being introduced abroad, and demonstrations at the 1961 London Audio Festival resulted in an article in the British "Hi-Fi News." While awarding the new material honors after AB listening tests and praising its anti-static properties, the author balks at the claim that a self-replenishing groove lubricant reduces the tendency of the stylus to "skate" up and down the side walls. The term "pinch effect" might be more accurate and do away with any confusion, as friction when high frequencies narrow a groove is what causes the stylus to ride up side walls. Lubrication does lessen friction and help the stylus "skate" through a narrow passage, but this term usually refers to a tone arm moving across the record surface after a broken side wall or other defect forces the stylus to jump out of the groove. Finally, the magazine's experts tried taking measurements to confirm the impressions of listening tests. Any differences proved too slight to account for the improvement, so the article is titled "The Polymax Mystery." The answer lies in the Fortissimo XK and Stereo Workshop Series, and quite a few record buyers will judge it to be the solution of their toughest problem.

Joe Gordon: Lookin' Good **Contemporary Stereo S7597**
Dexter Gordon: Doin' All Right **Blue Note Stereo ST84077**

Although both claim the same last name, the real bond between these two men is the part they are playing in the revitalization of jazz in and around Los Angeles, a region still less than wholly receptive to the unadulterated product. However, the vaunted climate is proving especially beneficial at the moment for rejuvenating battle-scarred veterans and raising a vigorous new crop of youngsters. Neither category quite fits Joe Gordon, whose trumpet playing won admiration in his native Boston and for the last three years in California, yet this is his debut album as leader and composer. It marks a great forward step for the former Dizzy Gillespie protege, and trumpet fanciers are advised to give first priority to the nine originals contained therein. The creative humor of the writing is best indicated by some of the titles, and a healthy future should be in store for anyone able to think up *Terra Firma Irma*, *You're The Only Girl In The Next World For Me*, and *Non-Viennese Waltz Blues*. Aside from bassist Jimmy Bond, the quintet introduces members of the new crop, including Jimmy Woods, an alto saxist of great promise, pianist Dick Whittington, and drummer Milt Turner.

Dexter Gordon's return after ten years of relative inactivity closely parallels the resurgence of Howard McGhee, another resident who is back in the limelight, but he had to visit New York to get back in a recording studio again. Greater maturity and close attention to tonal niceties are evident during the ballad *You've Changed*, and the tenor saxist shifts from low to upper register without a hitch. He gradually gathers steam on George Gershwin's *I Was Doing All Right*, and *It's You Or No One*, until all the old fire bursts forth on two originals. Stereo affords all the room needed to turn a beautiful phrase or go loping off in pursuit of Freddie Hubbard's trumpet, and both feats are performed with deceptive ease and a warm, full-bodied sound. The Horace Parlan trio provides rhythm backing, with the leader on piano, George Tucker, bass, and drummer Al Harewood.

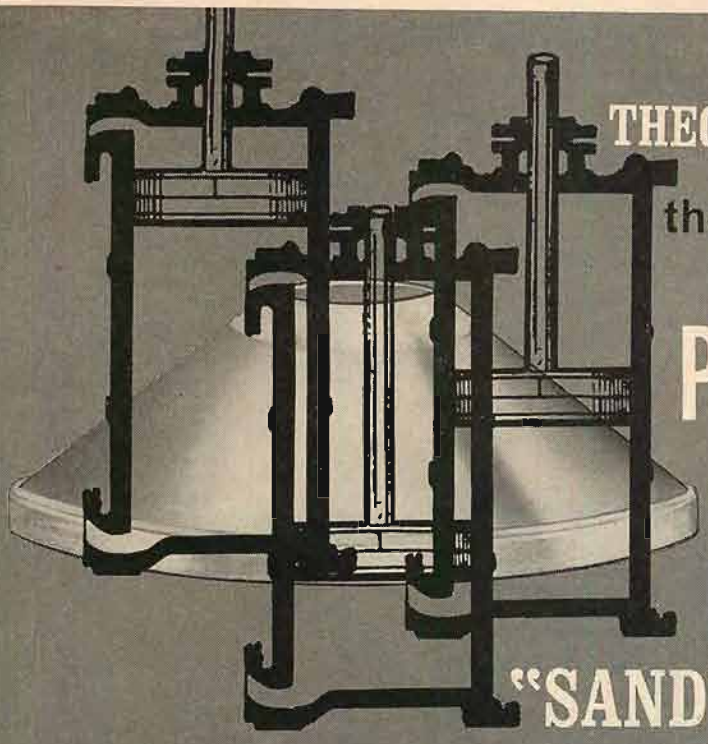
Riverside Jazz Stars: A Jazz Version Of Kean **Riverside Stereo RLP9397**

This jazz version of a Broadway musical is neatly arranged to make the nine Jazz Stars sound like fourteen ordinary players, and the trio responsible for turning the trick consists of Jimmy Heath, Ernie Wilkins and Melba Liston. Spreading the writing chores around increases the odds in favor of a more varied treatment, yet the risk of conflicting viewpoints spoiling the whole was slight in this case. The division of labor is fairly even, with both ballads and swingers being shared by all, and everyone hews to the current jazz line.

In fact, if the flamboyant Kean were alive today, he might consider the untimely demise of the show bearing his name and forego the stage for a career in jazz. He would probably feel right at home and ready to take part in

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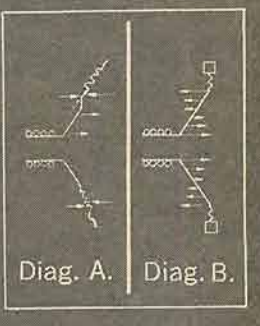
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the stereo conversation between Blue Mitchell and Ernie Royal on *Penny Plain*, even though the trumpeted street cries sound closer to Charleston than to 19th century London. And his lost youth would be restored on hearing Clark Terry's poetic flugelhorn on *To Look Upon My Love*. Jimmy Heath, tenor sax, and pianist Bobby Timmons also take starring roles, and others in the cast include Julius Watkins, Ron Carter and Al Health.

Gary McFarland: How To Succeed In Business Without Really Trying
Verve Stereo V68443

As this helpful guide to the corporate way of life seems to be entrenched for several seasons on W. 46th St., quite a few arrangers are likely to attempt jazz versions of the Frank Loesser score from time to time. If they hope to outdo Gary McFarland's success with this first venture, everyone concerned had better abandon the precepts of the book and really try. A youthful vibist from the West Coast, McFarland has branched out as composer and arranger since migrating east, writing for Gerry Mulligan, Anita O'Day, Johnny Hodges and Bob Brookmeyer. He tackles his debut album with a zest and enthusiasm befitting any junior executive, and the managerial eyes of all major labels are sure to watch his progress from now on. Most of the songs are tied to characters or situations on the stage, but McFarland removes all such shackles and treats each theme as freely and expansively as the big boss would entertain a prize customer on an evening out. The energetic title tune is uplifted further by a touch of gospel fervor, and a blues feeling adds to the nostalgia of *Grand Old Ivy*.

McFarland trusts the book's main premise enough to delegate the authority for numerous ad-lib choruses. Much of his success results when the trying is turned over to such competent members of the sixteen-man staff as Phil Woods, Bob Brookmeyer, Oliver Nelson, Hank Jones and Kenny Burrell. In fact, he practically loses the hero's role to Clark Terry, whose trumpet and flugelhorn work is witty and lyrical throughout. If Terry keeps on devoting so much attention to show tunes, a sign may go up on his desk someday bearing the title "The Thinking Man's Jonah Jones." McFarland wisely places several healthy solo bids himself, at just the right moment to send his stock as vibist soaring.

Henry Mancini: Combo!
RCA Victor LSP2258
Jonah Jones: Broadway Sings Again
Capitol Stereo ST1641

While many factors enter into the makeup of a combo, there are really only two kinds —those that play arrangements and the others. Extremes of both types take the field on these albums, with Henry Mancini holding up the arranger-composer's end in his usual masterful fashion. In fact, it would require the combined efforts of Peter Gunn and Mr. Lucky to find another nonplaying conductor of combos in all jazz history, unless Jackie Gleason qualifies.

But then, Mancini's duties in the studio may simply consist of giving everyone stereo cues, as quite a few startling effects are brought off at this session. Johnny Williams plays the harpsichord so that it sounds like rhythm guitar, then Bob Bain's bass guitar manages to equal Big Ben tolling the hour in reaching tonal depths on *Dream Of You*, while Larry Bunker alternates from marimba to vibes and imitates Bobby Timmons soloing on *Mounin'*. Of more substantial nature are several clarinet passages from Art Pepper, and drummer Shelly Manne duelling with Ramon River's congas on *Tequila*. Although Mancini drops broad stylistic hints in the direction of famous combos, the only influence frankly admitted is Raymond Scott's drawing room manner on *The Powdered Wig*. As on all Mancini's recordings, engineer Al Schmitt again does the honors.

Jonah Jones probably last read an arrangement when playing in the "Porgy and Bess" pit band nearly ten years ago. His brand of rugged individualism makes his quartet a one-man operation, and his success formula is melody, a variation or two, and then more melody. And once he knows the tune, the muted-trumpet variations could go on all night. Happily, one of his sets of Broadway show tunes each year seems to be part of Capitol's permanent planning. Among the hits of the past season are *Make Someone Happy, Good Clean Fun*, and *Hey, Look Me Over*. Also reprised are a few mellowed with use, including *Almost Like Being In Love*, and *I Wish I Were In Love Again*.

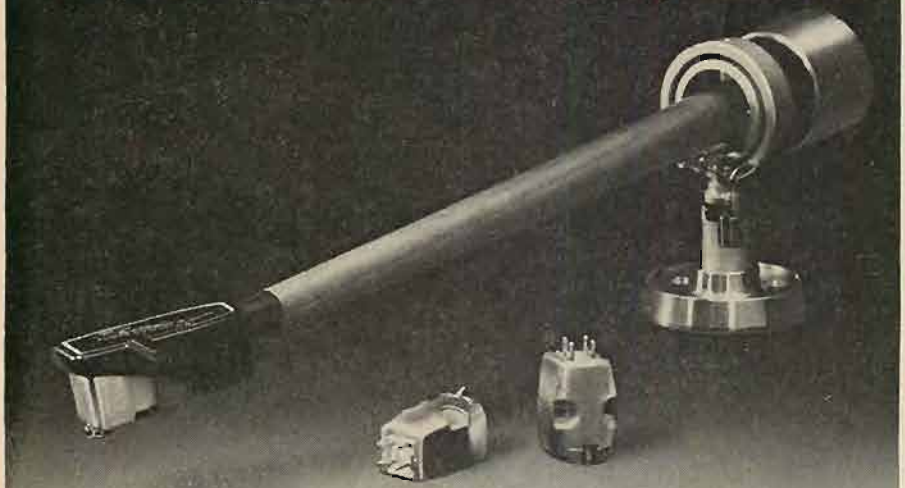
Al Hirt: Horn A-Plenty
RCA Victor Stereo LSP2446

Apparently neither Al Hirt nor Billy May stepped on the scales before and after this exhibition bout, as there is no listing of the poundage lost by the two hefty gents. After working as sparring partner with so many girl vocalists, May seems happy to be back in the heavyweight division again, and he unwraps a dozen strenuous arrangements to give the trumpeter from New Orleans his most thorough workout yet. No less than twenty top Hollywood studio musicians help out at the event, responding to May's every request and shining the bright light of stereo on the main soloist. Both men prance vigorously through *Rumpus*, and *Holiday For Trumpet*. And they show great heart and stamina during the clinches on *Margie, That Old Feeling*, and *Love Makes The World Go 'Round*.

When thrown in the ring with an extrovert like May, the flamboyant Hirt acts more at home than he did at his previous match with Henri Rene's strings. If anything, he indulges in fewer stylistic excesses out of deference to a trumpet section that boasts Mannie Klein and Conrad Gozzo. By way of variety, May lets the saxes rest for several rounds, substituting five French horns to good effect, especially when the full brass choir

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sounds on *Swing Low, Sweet Chariot*. In the joint capacity of engineer and referee, John Norman treats both contestants alike and never permits one to overpower the other.

Jo Basile: Jo Basile's Paris
Audio Fidelity Stereo AFSD5955

After playing attendance on a sum total of sixteen albums for this label, Jo Basile returns from a grand tour of the international scene to the city of his first success. Massed strings furn out in welcome, swelling the ranks of the little bal musette ensemble which supported the leader during his travels. The home-coming party takes place in a spacious ballroom, and the sumptuous setting is in sharp contrast to the group's plebeian beginnings. Basile's accordion purrs contentedly among the silken strings, but he may have slipped away to a neighborhood block party to end the evening in plainer surroundings.

The songs chosen are popular in either place, even a noble visitor from Britain titled *Greensleeves*, and include *Gigi*, *Sous Le Ciel De Paris*, and *Melodie D'Amour*. Three Monnet pieces comprise a special treat. Full advantage is taken of the extra personnel to increase the dimensions of the stereo stage, and the strings acquire a romantic bloom in the excellent recording.

The Limeliters: Sing Out!
RCA Victor Stereo LSP2445
Bob Grossman
Elektra EKL215

After a series of appearances in packed clubs and noisy auditoriums, even the inside of a recording studio must seem inviting. Besides, ample proof already exists of the explosive way audiences react when The Limeliters let fly, and examples of the sharp humor of Lou Gottlieb's introductions also are plentiful. Apart from dispensing with preliminaries, the trio sings out with accustomed high spirits and compensates for the omission with hilarious asides directed at the control booth of RCA's Music Center of the World in Hollywood. One member benefiting from quiet surroundings and excellent stereo is Glenn Yarbrough, whose tasteful solo passages proceed without interference on *Everywhere I Look This Mornin'*, *The Little Land*, and *A Warfaring Stranger*. Alex Hassilev leads everyone back to the open road on *Golden Bell*, and *Joy Across The Land*.

Interviewers have quoted the Limeliters on the price of success and the strain of constantly singing together, an affliction which caused a split in The Kingston Trio. The chance to relax in the studio helps this time, but a long vacation may still seem attractive to one member or another. If a substitute is ever needed, the two survivors might do well to draft a rising new star on the label which gave the Limeliters a start.

Bob Grossman set out on a folk singing career after graduation from high school and acquired stage presence during a nine month stay at the Unicorn in his native Los Angeles. The twenty-year-old youth is now packing a guitar around the circuit traveled by all folk aspirants, and this debut album finds him enlivening the night at the Buddhi in Oklahoma City. Dipping into an international bog of folk material, he keeps the populace alternately enthralled and enthusiastic enough to indulge in group participation. Attesting to his versatility are such diverse items as *Viva La Qunice Brigada*, *Vayiven Uziahu*, and *Buked And Scorned*. No stereo version is available, but Grossman will be heard from again and again.

Modesto Duran: Pachanga, Anyone?
World-Pacific Stereo 1414
Mariano Mores: Mexico
Capitol Stereo ST10292

The atmosphere in Latin American music is so heavy with the pollen of cross-fertilization that hybrids of all sorts are turning up. However, these albums come from hardy stock and the incidence of foreign strains remains relatively low, especially when Mo-

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

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

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At this writing, the first 1962 issue is being completed, and will be ready for mailing to Society members soon after this advertisement appears. Among the equipment articles are:

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desto Duran's Charanga Kings occupy the stand. The instrumentation consists simply of violins and cello, a wooden Cuban flute pitched high enough to sond like a piccolo, plus a rhythm section featuring the jawbone of an ass and the leader's conga drum. Born in Havana, Duran got his start with Gilberto Valdes orchestra, played in Mexico with Esquivel, toured seven years with Maria Antonietta Pons, and his three-count conga beat helped the original Perez Prado group introduce the mambo. After coming to the United States, he worked with Ertha Kitt, Lena Horne, Herb Jeffries, and set the rhythmic pace for Harry Belafonte's first calypso album. With all these credits to look back on, Duran ventures forth as composer of nine of the dozen tunes, most of which move to a pachanga beat. One exception worthy of note is *Sere Feliz*, a lyrical and pulsating bolero, while another brings the chachacha to Les Baxter's *Quiet Village*. The sound of Domingo Vernier's fabulous flute obbligatos repays the purchase price, and Olguita supplies pert vocals. Oliver Berliner's supervision assures sterling stereo reproduction.

Mariano Mores introduces five new works from "Luces de Buenos Aires," a musical show which he presented with great success in Mexico City, where this album was recorded in excellent stereo. While the performances of the large chorus and orchestra may seem a bit theatrical, the leader's arrangements are full of surprises that break through the shimmering surface. His touch at the piano is firm, flexible and sparkling in the best tango tradition. The fiery Argentine rhythm gives a luminous new look to the one outside visitor, *The Song From Moulin Rouge.*

Joe Harnell: The Sound Of The Asphalt Jungle

Kapp Medallion MST47018
(4-track UST tape)

No doubt record producers spend as much time looking for tags to hang on albums as they devote to preparing the contents. Names of popular television shows fill the bill splendidly, if a pact that is mutually agreeable can be worked out, and why a natural like "Person to Person" was neglected still remains a mystery. Joe Harnell beat out competition before to gain the rights to "Naked City," and it must have sold copies or this sequel would never see the light of day. As far as Harnell is concerned though, the set's primary purpose is to provide swinging, danceable music, and fancy titles or stereo fireworks are just so much extra frosting. Apart from the theme and a little thing of Harnell's called *Midnight Madness*, the tunes are all standards accustomed to both country club life and the urban scene. Harnell's arrangements deserve to be classed with those of Nelson Riddle and Gordon Jenkins, and his piano passages are smartly styled. While sections of the large orchestra are at liberty to leap about in stereo, the beat always remains within reach. Dancers can sail forth with this tape confident that it will not become too spectacular for comfort.

MONO

Pink Anderson: Carolina Blues Man, Vol. 1
Prestige/Bluesville 1038

The Carolinas nurtured a goodly number of blues singers throughout the years, but this is the first visit paid to the area by any of the contemporary lot of folk material gatherers. Pink Anderson worked most of his life as a medicine show entertainer, traveling for thirty years with Dr. Kerr to help peddle miraculous cures put out by the Indian Remedy Company. Seasons when the show was off the road, he sang rural blues and played guitar with a trio around his home in Spartanburg, until heart trouble finally put an end to outside activities a year or so ago. Now in his sixty-second year, Anderson can look at the blues with a dispassionate eye, and the ten here are sung with a detached and reflective air. Perhaps the virtues of understatement were learned in the tent shows, where the next act always promises to

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

According to another theory, the trait is regional and helps distinguish the local product from less temperate outpourings usually heard to the southwest. Supporting this claim is the influence of Blind Boy Fuller, who was the first resident of the Carolina hill country to record with any success. But Fuller had a bass voice, unlike most blues singers, and it must have shaped his style, as little restraint shows in the falsetto of Sonny Terry, another native son and early pupil. Thanks to the efforts of two adventurers with a tape recorder, producers Sam Charters and Ken Goldstein, blues collectors can work out their own solution while listening to Anderson sing four pieces associated with Fuller.

Claude Hopkins: Let's Jam
Prestige/Swingville 2020

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

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

Don Ellis: New Ideas
Prestige/New Jazz 8257

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

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

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

Jim Copp and Ed Brown: East of Flumdiddle
Playhouse 404

While the exact location of the title's imaginary land of bright nonsense never becomes known, it must be somewhere along a route already traveled by Hans Christian Anderson. Several of the master storyteller's tales are borrowed by Jim Copp and Ed Brown to complete this fourth annual collection of song and fable. Fortunate owners of earlier entries in the series are aware that considerable audio know-how goes into the preparation of both original and adapted material. The two collaborators call on a number of electronic skills to account for ninety different voices, including all the inanimate objects met on the way. Whenever a situation calls for sound effects, some of the most realistic noises ever to come through loudspeakers are heard. Not only does the audio action keep young audiences quiet for the moment, but it opens tender ears to the imaginative use of everyday sounds. Among the characters and places visited this year are a basso profundo lady toad, an A.W.O.L. French toy soldier, a one-inch maiden, a hen with a low I.Q., and the castle of Tin Pan with its magical garden of audible fruit.

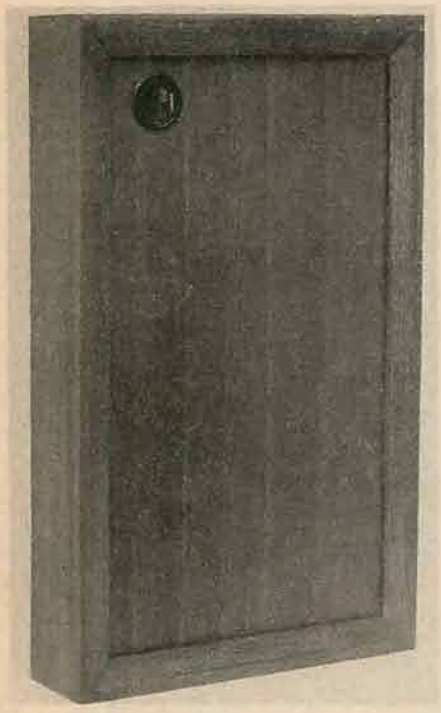


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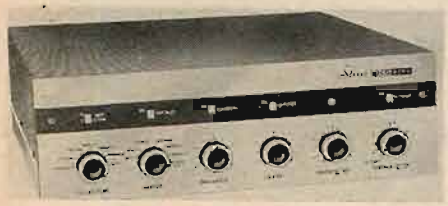
NEW PRODUCTS

• **Thin Speaker System.** Advanced Acoustics announces a new addition to their line of Bi-Phonic Coupler speaker systems. The new unit, called the Wafaire Bi-Phonic Coupler, uses a new method of construction which helps improve performance while at the same time reducing cost. The Bi-Phonic coupler does not use cone-type speakers, but instead the wooden panel vibrates as a single piston in an unbaffled arrangement. Dimensions of the



Wafaire are 13½ x 21¾ x 3⅜. The unusually shallow depth of the system permits it to be placed in a variety of locations not ordinarily compatible to speaker systems. It requires only 10 watts of clean audio power and its impedance is 8 ohms. The Wafaire is available in mahogany, oiled walnut, or lacquered walnut finish. Price is $69.50 individually, or $124.50 for a matched pair. Advanced Acoustics Co., Cedar Grove, N. J. **C-1**

• **Stereo Preamp.** The new Eico Model ST-84 stereo preamp features distortion levels of 0.05 per cent or less at all levels of all functions. Styled to match the Eico "New Look" line, its brushed cast-aluminum faceplate is gold anodized with brown accenting band. Input and mode selectors each have seven positions. Switches control low- and high-frequency filtering, equalization of 3¾ and 7½ ips tape speeds,



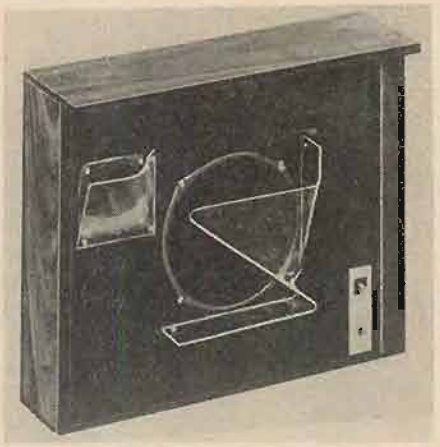
tape monitoring, and loudness contour. The unit is self-powered. Frequency response is ±0.3 db from 5 cps to 25,000 cps. Harmonic distortion from 20 cps to 20,000 cps is 0.06 per cent at 2 volts output. Intermodulation distortion is 0.04 per cent at 2 volts output. Tone controls provide 15 db cut and boost at 50 cps and 10,000 cps. Price is $59.95 in kit form and $89.95 ready to play. Eico Electronic Instrument Co., L.I.C., N. Y. **C-2**

• **48-Watt Amplifier.** H. H. Scott has made available a 48-watt stereo amplifier kit. The new kit, Model LK-48, includes features such as separate bass and treble controls for each channel, a stereo balance control, front panel tape monitor facilities, and derived center channel output. Although rated at 24 watts per channel, the LK-48 is claimed to deliver 28



watts (IHFM) at low frequencies. For ease of construction the manual shows parts in their actual color. Parts come mounted on separate "Part-Charts," one for each page of the instruction book. All wires are pre-cut and pre-stripped. The kit arrives in a "Kit-Pak" container which opens to form a work table. All mechanical parts are riveted to the chassis at the factory. Price of the kit is $124.95. H. H. Scott, Inc., Maynard, Mass. **C-3**

• **Hide-away Speakers.** Featuring the "reflection coupler" speaker system the Ravenswood M50W speakers are small enough to be hidden out of sight behind a couch, and handsome enough to be in view. The M50W systems in a stereo setup



will handle 35 watts of program material and dispersion with the reflectors shown is 180 deg. Impedance is 16 ohms. Each unit measures 20-in. x 16-in. x 6-in. Price for the M50W is $49.95 each in utility black or $54.95 finished in oiled walnut. Ravenswood, Annapolis, Md. **C-4**

• **FM-Stereo Receiver.** The new Stereo Festival III by Harman-Kardon, Model TA5000X, is a versatile high fidelity music center for the home. It features separate



AM and FM tuner sections for standard broadcast reception, an integrated FM-stereo adapter, two 25-watt amplifiers (music power), and complete control facilities for monophonic or stereophonic listening. The Stereo Festival III includes a d'Arsonval tuning meter, separate tone controls, blend control, stereo indicator lights, front panel headphone receptacle, and an illuminated pushbutton on/off switch. Price of the TA5000X is $299.95. A walnut enclosure is available for $29.95. Harman-Kardon, Inc., Plainview, Long Island, N. Y. **C-5**

• **Professional Turntable.** Designed to solve the rumble problem highlighted by the introduction of stereo broadcasting, the Fairchild Model 750 is claimed to be the first 16-in., 3-speed, belt-driven turntable offered to the broadcast industry. Rumble is −65 db below a 1000-cps signal at 5 cm/sec. Wow and flutter are below 0.03 per cent, clearly indicating the advantages of a belt drive. On the other hand, one of the main disadvantages of the belt drive, stretching of the belt, have been



eliminated by the use a 2-speed synchronous motor. Also, speed change can be accomplished while the turntable is revolving, and is sufficiently quiet to permit operation very close to open studio microphones. Other features include a 35-lb. aluminum-filled platter and a front dress-plate for mounting controls. Semi-automatic operation is available with the use of the new Fairchild "Third Hand," an automatic attenuator. The price of the turntable unit on a top plate is $485.00, and in a cabinet (illustrated) $550.00. Fairchild Recording Equipment Corp., Long Island City, N. Y. **C-6**

• **FM-Stereo (Multiplex) Tuner.** Featuring a front-panel switch for the multiplex section, the Lafayette LT-700 indicates stereo by means of a front-panel light. The FM



circuitry includes a low-noise front end with triode mixer followed by double-tuned dual limiters and a wide band Foster-Seeley discriminator. Separation is given as 35 db at 400 cps and harmonic distortion is less than 1 per cent from 50 cps to 15,000 cps. Over-all frequency response is within 1 db from 50 cps to 15,000 cps.

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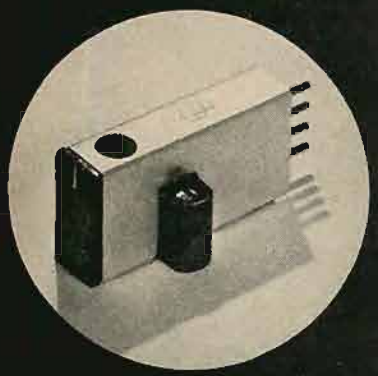
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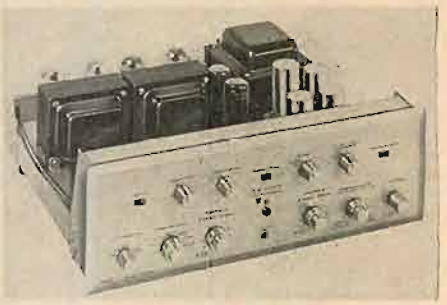
The LT-700 is handsomely styled in cream and brushed-brass finish on the front panel and is set in a beige-finish vinyl enclosure. Price of the LT-700 is $124.50. Lafayette Radio Electroics Corp., Syosset, L. I., N. Y. **C-7**

• **Automatic Level Control.** Incorporating the most recent advances in solid state and computer technology, the CBS Laboratories "Audimax" automatic level control device automatically maintains maximum modulation or recording level. Audimax is offered in two models: Audimax I employs a "platform" concept which automatically readjusts the gain "platform" to



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• **100-Watt Complete Stereo Amplifier.** Exceptionally high power and flexibility which makes it equal to many separate units distinguishes the new H. H. Scott Model 296. Among the features of this unit is the patented "Dynaural Rumble Suppressor" which removes turntable or record rumble during playback without loss



of audible music. Each section delivers 50 watts IHFM from 20 cps to 20,000 cps. A variable phono level control permits precise matching to any phono cartridge or tape deck. Other features include a stereo selector switch, a front panel stereo headphone output, and a derived "center channel" level control. H. H. Scott, Inc., Maynard, Mass. **C-9**

AUDIO ETC

(from page 14)

2. THE AUTOMATIC ARM

A good many years ago, I decided that eventually the phonograph arm was going to get smaller and smaller, as pickup elements grew lighter and more delicate, until it would somehow resolve itself into a purely automatic tracking device—a minichanger that would eliminate the coarse human hand altogether. Well, it's funny, but it hasn't happened.

For one thing (speaking superficially), the age-old half-inch mounting center for pickup cartridges, dating back to the early crystal period in the 1930's, still sticks with us today, carrying with it the necessity for a large "head" on the arm, its minimum dimensions determined by the need for interchangeability between cartridge models. There are big cartridges and small ones, but all of them toe the half-inch line in this particular respect—except for a few special models that have now and then broken away, such as the Pickering Uni-Poise or the Shure Studio Dynetic.

Thus today virtually every arm still has a very swelled head. And a big head tends to require a fairly big arm to support it, if only for looks. Not too many recent arms have sported big heads on spindly "necks," though from an aesthetic point of view the thin-tube type of arm, done rightly, can be handsome.

Three-Way Designing

The technicians will be screaming at me here that aesthetics come last and what counts isn't arm size at all nor even the head size, but those much more vital basic parameters that go along with all these externals—arm mass, tracking geometry, the assorted weights, drags and inertias, both vertical and lateral, that must be balanced against the changing mechanical parameters of stylus design within the cartridge itself. Right! I'm not dumb enough to bypass such considerations (out loud).

Nevertheless . . . the total consideration in an arm does involve three major factors, only one of which is strictly a matter of engineering performance. The pickup arm is designed for people and for the home. Aesthetic appeal may be the last factor of importance but it's there just the same, and permanently. And there is that even more important human factor, increasingly our concern these days, the cybernetics of the design, the human engineering. Your arm must be developed, you see, as part of the human machine with which it will operate; it must be "coupled" to human energizing motions and to human thinking and habits. Since we haven't yet been able to redesign the human arm itself, and in particular to miniaturize it, we seem to be more or less permanently stuck with its macro-energy and its relatively coarse movements, as a source of motive power.

If you ask me, that is really the basic reason why we still have the big arms and their swelled heads, though I'll admit that the geometry of the 12-in. LP record has a wee bit to do with it.

In a way, you can think of pickup arm designing (cartridge taken into consideration, of course) as a kind of constant juggling of various methods of suspension and of motion, to see which one works out best at a given time, for a given set of factors in relation to the unchangeable human being. Remember the 6-oz. RCA magnetic pickups of around 1930? I used one. When those beasts went into operation via the hand the main danger was the needle—and the danger wasn't to the stylus. You could stab yourself ½-in. deep

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with no trouble at all. You could also stab the record, breaking the point or digging holes. Once on the disc, however, the arm didn't really present much of a tracking problem. It *had* to track, with all that weight, and no two ways about it, so long as the shellac record was in one piece.

And then there was the first "lightweight" arms, along just before the war. Point pressure was reduced to an uncanny lightness—one ounce. I evolved a standard test method for "needle" pressure in those days. Lift the arm by lifting the stylus point with the ball of a finger. If the point drew blood, the pressure was too great. If it merely pricked a bit, it was all right.

If you think back over this long period, you'll find the basic thinking for each design more or less as I have described it. As the designer works out his formulae or follows his intuitions and brainstorms, adjusting the angles, the weights and the counterweights, the pivots, bearings, springs, scales and, of course, the aesthetics, he must think inevitably—first get it to work with current equipment; then get it to work with *people,* who are always "current;" and finally, make it pretty. This tripartite operation brings up something different each time the changing factors are lined up for a new look.

Each advance in cartridge construction means a new set of readjustments or redesignings in the arms that take the cartridge. Stereo, for example, produced the biggest disruption in arm design since the beginning of phonography. We aren't yet entirely recovered, after a good three years, from the fuss stirred up when vertical cartridge response was added to lateral. Arm after arm has appeared, or reappeared modified; type after type has been tried; old types like the once-popular viscous-damped mono arm have been largely retired, or drastically altered to meet the new needs. New sorts of arms have turned out to be best for stereo.

A small repercussion of a typical sort comes to mind. A year or so back I got a new arm to try out—I won't name it now, having more to say about it later on. Just lately I mounted that arm in a new set-up to take a brand new cartridge put out by the maker of the arm itself. Well, there was only about a year's time-lag between the two, but the new cartridge was so light in weight that the arm wouldn't adjust to it and proceeded to float happily in mid-air! Obviously, the company had not foreseen its own cartridge when it designed that arm—though I suspect minor changes have since taken care of the difference. I strapped a penny on top of the shell, to bring it down to earth.

Grado

And so, with these general thoughts in mind, I turn to mention of an interesting arm I've used for these last several months in my main listening system, the Grado arm, plus its complementary Grado cartridge. (Bless me, I can't figure at this point which of the Grado grades this one is, but I think it's the best, out of three. No identification on it. Anyhow, it's small, strictly rectangular and a soft gold in color, with a *very* compliant stylus, emerging from a protective rubberish guard.)

Let me talk of the arm—but I'll have to say in passing that the Grado cartridge is one of those that just plays and plays, producing top-quality sound for me without any complications at all. If it varies from other top cartridges, it is in those micro-respects that fascinate hi-fi listeners but tend to affect musicians in that they like their music the better, or praise the recording, or the amplifier—even the performance itself. "Wow—what superb Bach!," they'll enthuse. And all the time it was just the cartridge, doing a superb job. What else is a cartridge for.

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

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

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



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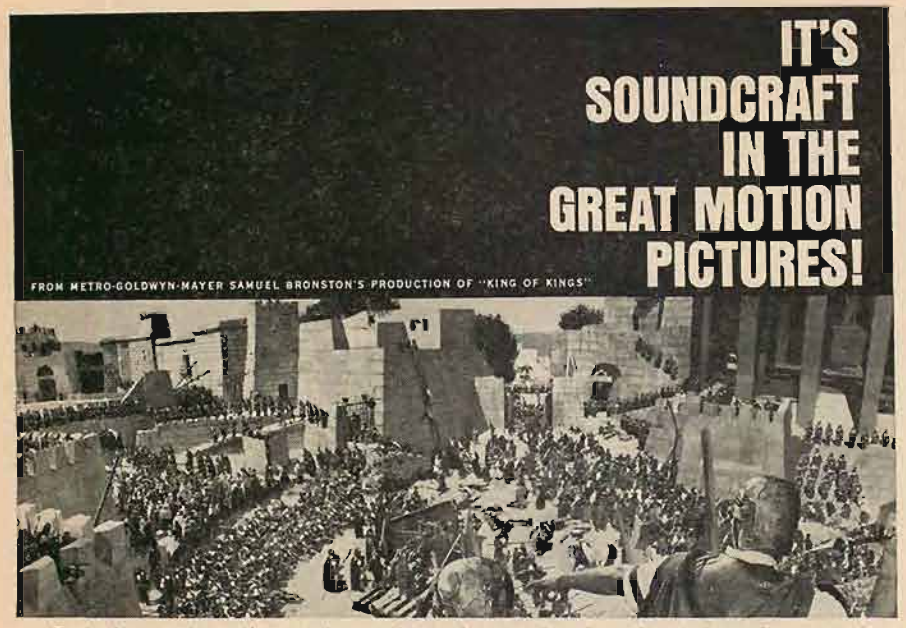
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little sliding weight on a track to the right of the main arm, with a setscrew. For this adjustment you tip the whole turntable 'way over, then balance the side-pull (now a partial down-pull) of the offset head and cartridge against the sliding weight. Again, same idea as in the other arms, bu this one is undeniably convenient and easy to adjust.

Finally, after balancing both ways, you turn a small knob over the arm pivot and the third major adjustment, stylus force, is made via a spring inside. Also similar to other arms of this general type.

It would be nice if someone could devise an "absolute" scale of grams for this type of spring stylus adjustment. But that, I fear, is impossible unless all cartridges are standardized at identical weights (and all springs made to pull at a permanently standard tension, another unlikelihood). As with other arms, you must measure your own stylus force at this stage; but Grado tries to help via one of those ubiquitous penny balances. For once, Mr. Grado becomes imprecise, as I suppose he had to, pennies being pennies. It says "2 pennies equal 1 gram. Each additional penny equals 1 gram. 4 pennies equal 3 grams." Baffled by this arithmetic, I went out and dug up my old Audax stylus-force measurer, the one with the little donut weights. No pennies, thanks.

There are still other neatly designed adjustments, once and for all, on this Grado arm—I forgot an important one, a sliding motion at the cartridge mounting which allows you to center the stylus tip exactly at the optimum point for best tracking. Excellent idea, and it should be provided on all general-purpose arms.

In use (after these preliminaries), I found the Grado to be cybernetically near ideal for its type. A neat little arm rest, for instance, in the right place, with a small magnet mounted in the arm itself to hold it down. Unlike other magnetic arm rests I've tried, this one cannot bounce, a dangerous habit when the magnetic pull is sidewise and unaided by more conventional holding power. This arm drops downwards into a rectanglar socket that just fits; the magnet merely serves to hold it lightly in place. Excellent. (But the magnet kept coming loose. I re-stuck it with rubber cement.)

The other vital element in arm handling, the lowly finger lift, is also exactly "right" here—where in so many fancy arms it is overly complex, clumsy, fussily delicate and/or badly placed. The simplest is really the best, just the old-fashioned curved hook, for one fore-finger. There isn't anything better.

Only one minor problem turned up, an easily repaired defect. The cartridge at first produced only one channel and for awhile I thought I was up against some more of those Canby gremlins. Couldn't get a peep out of the other half. It turned out to be a slight warping of the plastic contact fingers on the cartridge mount. Common enough in this sort of material and not hard to remedy with a bit of warmth.

I think the most impressive aspect of the Grado arm, over and beyond its compactness and its ease of adjustment, is simply a feeling of security that it provides in actual use. Not easy to pin down, for it is a result of many factors; but the over-all lightness of mass has to do with it. No big hunks of metal swinging dangerously around, no long projections to snag, no clumsy or over-delicate handling facilities.

If you want a short arm, if you want in particular an arm that goes easily in a small cabinet, a tight corner, a cramped work space, yet has "everything," this Grado model is surely for you. Æ

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ELECTRONIC ORGAN TONE GENERATORS

(*from page 32*)

8. Alan Douglas, "Frequency division circuits for musical instruments." *Electronic Engineering*, September, 1960.

9. R. H. Dorf, "The Conn electronic organ." AUDIO, September and October, 1956.

10. R. H. Dorf, "Electronic organ uses neon tone generators." *Electronics*, August, 1958.

MFG.	MODEL	GENERATOR	WAVE SHAPE	DIVISION	REMARKS
ALLEN	T-44 ORGANETTE T-12a, RONDO, EMPIRE T-15a, b, SHERATON TC-1, TC-3, TC-4, TC-6	MODIFIED HARTLEY	SINE WAVE	INDIVIDUAL OSCILLATORS/ NOTE	KEYED PLATE OSCILLATORS
BALDWIN	MODELS 5A, 10A 30, 45 SERIES 51	MODIFIED HARTLEY	SAWTOOTH	TRIODE DIVISION	
CONN	621 SERENADE 710 ARTIST 810 CLASSIC 820 SUPER CLASSIC	MODIFIED HARTLEY	SAWTOOTH & SINE WAVE	INDIVIDUAL OSCILLATORS/ NOTE	KEYED PLATE OSCILLATORS
	430 540	MODIFIED HARTLEY	SAWTOOTH & SINE WAVE		CONTINUOUSLY RUNNING OSCILLATORS. TOP OCTAVE DERIVED BY DOUBLING.
ELECTRO-VOICE	BARON BARONESS	MODIFIED HARTLEY	SAWTOOTH	NEON TUBE FREQUENCY DIVISION	
	"D"	PRE-RECORDED AIR ORGAN SOUNDS	COMPLEX		
ELECTRONIC ORGAN ARTS	ALL MODELS	MODIFIED HARTLEY	SAWTOOTH & SINE WAVE	INDIVIDUAL OSCILLATORS/ NOTE	
ESTEY	521 541 721 741	MODIFIED HARTLEY	SAWTOOTH	NEON TUBE	
GULBRANSEN	ALL	MODIFIED HARTLEY	SAWTOOTH	TRANSISTOR	
HAMMOND	SELF-CONTAINED CHURCH HOME CONCERT	ELECTRO-MECHANICAL	SINE WAVE	INDIVIDUAL PICK-UP COIL FOR EACH NOTE	DISTINCTIVE HAMMOND TONE
	EXTRA-VOICE CHORD SPINET	MODIFIED HARTLEY	SINE WAVE	SEPARATE OSCILLATORS/ NOTE	SOME TONE SHARING
KIMBALL	200 205	HARTLEY	SAWTOOTH	TRANSISTOR	NO POWER FROM OSCILLATOR. EXCITER LAMPS AND PHOTO TUBES FOR 12 TONE GENERATORS MUST BE CAREFULLY MATCHED.
	260 264 265 280 285 270 275	AIR ORGAN SOUNDS RECORDED AS OPTICAL PATTERNS	COMPLEX		
KINSMAN	ALL	GROUNDED PLATE HARTLEY	SAWTOOTH	NEON	2 NEONS USED FOR FREQUENCY STABILITY
LOWERY	ALL	HARTLEY	SAWTOOTH	TRIODE	TOP NOTE IS FIRST HARMONIC OF FUNDAMENTAL
SCHOBER	CONSOLETTE 1. CONCERT 2.	MODIFIED GROUNDED PLATE HARTLEY	SAWTOOTH	TRIODE	1. POWER TAKEN FROM OSCILLATOR 2. NO POWER TAKEN FROM OSCILLATOR
	SPINET 3.			NEON TUBE	3. VACUUM TUBE OSCILLATOR REQUIRES REGULATED B+. TOP NOTE COMES FROM VACUUM-TUBE OSCILLATOR.

TABLE. 2. Characteristics of typical tone generators.

THIS MONTH'S COVER

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

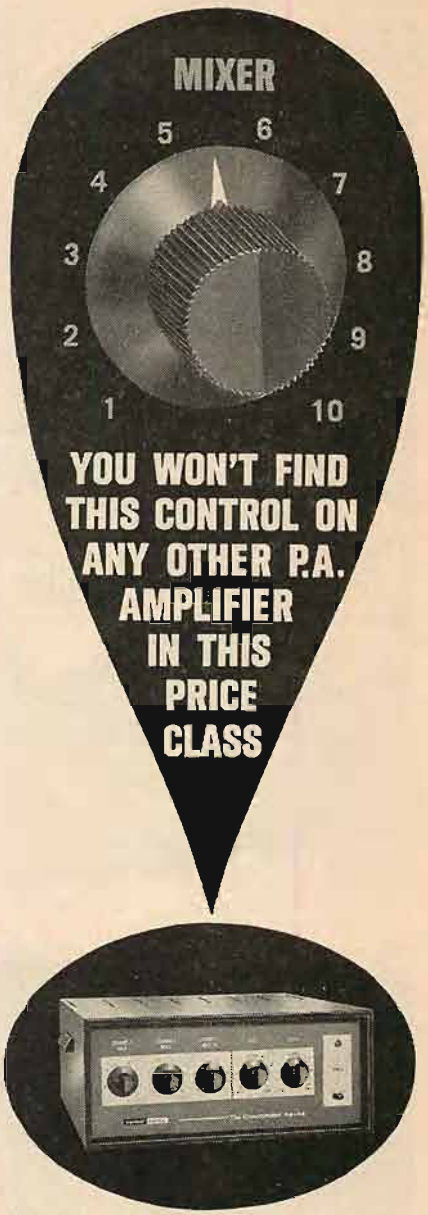
Sherwood S-4400 preamp, S-360 basic amplifier (not visible) and the S-3000 III FM-stereo tuner (with multiplex)

Telefunken M97 stereo tape recorder

Weathers K803 professional turntable and pickup system

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

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



Mixers aren't new. But one that will fade and blend two program sources with a single control is. That's one of the exclusive features on the new Harman-Kardon COMMANDER Series of public address amplifiers. Equally unique, yet typical of the exceptional value of this product group is an Anti-Feedback Filter which increases sound output by 100% under difficult acoustical conditions and Multiple Inputs for still greater installation flexibility. That's not all! The popular priced COMMANDER Series includes features usually reserved for costlier "deluxe" equipment such as: master volume control; input for magnetic cartridge; outputs for tape recorder, booster amplifiers and both 25 and 70 volt speaker lines; locking covers; DC on filaments of hi-gain stages, etc. Get all the facts now. Write Commercial Sound Division, Harman-Kardon, Plainview, L.I., N.Y.

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ABOUT MUSIC

HAROLD LAWRENCE

On French Opera, Not Grand

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

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

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

The French, who maintain separate though unequal facilities for their two branches of the musico-dramatic art, traditionally enveloped the *Opéra* in an aura of superiority. Composers for the stage regarded the *Opéra* as their ultimate goal. Even the most successful *opéra-comique* masters longed to penetrate the confines of the *Opéra*, where fluff and frivolity were spurned and noble music and high-toned libretti enshrined. The *Opéra-Comique* was to the *Opéra* what the Broadway musical theatre is to the Metropolitan Opera House.

Opéra comique was the rage of Paris during the years between the Restoration and the decline of the Second Empire. In keeping with the growth of Romanticism, it had lost much of the intimacy and satirical bite of pre-Revolutionary times, turning more and more to the typical melodramatic concoctions of the period and straying far from home for its subject material. Sir Walter Scott's novels were widely adapted by *opéra-comique* librettists, and, as early as 1797, Cherubini set the tragic and gruesome story of Medea to music. The orchestra increased in size from 40 players in 1790 to 70 some fifty years later. Despite this *rapprochement* in text and scope between the *Opéra Comique* and the *Opéra*, the former generally retained in approach and execution a lightness of style that consistently avoided pretentiousness—it was sentimental but never pathetic; its humor was down to earth, not epic; and philosophical overtones were conspicuously absent. Looking over some of the *opéras comiques* of the period, one is struck by the fact that there is very little real development of musical or literary ideas. Each theme (or should we say, tune) appears briefly and, with a pretty curtsy-cadence, makes way for the next; as for the personages, they are shallow, stereotyped creations. The storms and passions of *Zampa*, for example, with its Weber-like string writing and noisy climaxes, are not to be taken too seriously. Nevertheless, there is much to be admired from a purely musical viewpoint. A lively, boulevardier spirit animates the melodic line of an Auber score; Boieldieu's orchestration is often a model of clarity and full of piquant effects; and one finds numerous examples of elegant vocal and instrumental writing in the works of Adam and Hérold.

Today's musical public is familiar with the *opéras comiques* of these composers only through a handful of overtures which are included in "pops" concert programs. The near-total disappearance from the repertoire of this large body of music contrasts dramatically with the enormous and extended popularity which many of these works enjoyed during their day. Within two years after its première, Hérold's *Zampa* (1831) was performed in a dozen opera houses throughout Europe and in Moscow and New York; Boieldieu's *La Dame Blanche* (1825) reached the 1000-mark at age forty; and many others ran over a hundred performances. Berlioz, confronted with defeat and frustration in his operatic career, reacted with cold fury over the easy success of the *opéra-comique* composers, although he was fair enough to credit some of them with originality and craftsmanship in orchestration.

In recent years, quite a number of lesser known 18th- and 19th-century operas have been revived, either in stage or concert versions. As might have been expected, the majority of these revivals have consisted of obscure works by famous composers, not always a guarantee of high musical quality; e.g., Bellini's *Il Pirata*. But this operatic archaeology has unearthed some fine music, such as Rossini's *Turco in Italia* and Paisiello's *Barber of Seville*.

Mid-19th-century *opéra comique*, however, like Swiss wine, does not export well. Do not blame it on the librettists. Eugène Scribe, who wrote nearly all of Auber's books, was one of the foremost dramatic writers of his day. What of the music? Of minor significance in the history of opera, light in content and treatment, designed

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to "épater les bourgeois" (to delight the average Parisian audience)—hardly an unqualified recommendation. Yet, if *Fra Diavolo* is representative of the *opéra comique* style of the mid-1800's, it would be a pity to banish such music forever. What Rossini wrote of Auber could also apply to the best works of the leading composers in this carefree *genre*: "He may have produced light music, but he produced it like a great musician." Æ

LIGHT LISTENING

(*from page 10*)

Living Strings: South of the Border
RCA Camden CAS 682

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

Norman Luboff: Sing! It's Good For You
RCA Victor LSP 2475

Is the Norman Luboff choir being groomed for sing-along releases? Luboff's previous recordings on this label stressed arrangements that highlighted the virtuosity of the choir. Now we find the chorus occupied with a roster of tunes designed to stimulate listener participation. The mood is resolutely cheerful throughout a lineup that ranges from a Latin-paced *Happy Days Are Here Again* to swinging versions of *I Got Plenty O Nuttin'* and *It's a Good Day*. Listeners who object to the amount of reverberation found in some of the more famous sing-along albums that have been dominating the market will find little fault with the trace of echo that is suggested in this disc.

More Yves Montand
Columbia WS 380

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

FREQUENCY RESPONSE

(*from page 28*)

rise time—that is to say that it takes zero time for the voltage to rise from its zero level to maximum. However, when a square-wave signal is sent through an amplifier it will be found that a finite amount of time will elapse from the instant the rise starts until the peak output voltage is reached. This is due to limited bandwith. This passage of time can be defined as the rise time. Actually, the rise time is conventionally

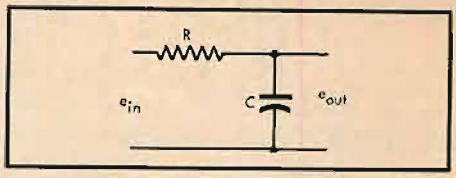


Fig. 8. Circuit with high-frequency rolloff.

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

Just what the relationship is between rise time and the upper frequency limit can be determined from *Fig.* 8. We can see that the upper frequencies are

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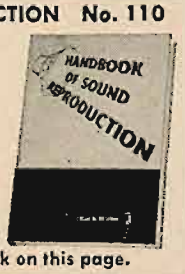
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limited by some configuration(s) similar to that shown. Here, the capacitor at the output results in a rolloff. The frequency at which the gain is down 3 db is $1/2\pi RC$. This can be seen when we consider the network as a voltage divider where

$$\frac{e_{out}}{e_{in}} = \frac{\frac{1}{j\omega C}}{R + 1/j\omega C} = \frac{1}{j\omega RC + 1}$$

The output is 3 db down when the denominator is equal to $1 + j$, or $j\omega RC = j$.

$$\omega = \frac{1}{RC} \text{ and } f = \frac{1}{2\pi RC} \qquad Eq.\ (12)$$

Now assume that the leading edge of a square wave enters the network shown in *Fig.* 8, causing the capacitor to charge gradually. The equation for this network is

$$e_i = V_C + V_R \qquad Eq.\ (13)$$

but $V_C = \frac{1}{C}\int idt$ and $V_R = iR$

therefore $e_i = \frac{1}{C}\int idt + iR \qquad Eq.\ (14)$

A solution[1] to this equation is

$$e_o = E(1 - \epsilon^{-t/RC}) \qquad Eq.\ (15)$$

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

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

$$0.9 = 1(1 - \epsilon^{-t/RC})$$
$$+0.1 = +\epsilon^{-t/RC}$$

Putting this into logarithmic form gives

$$\log_\epsilon 0.1 = -t/RC$$
$$-RC \log_\epsilon 0.1 = t = 2.3RC \log_{10} 0.1$$
$$(\text{for } \log_\epsilon = 2.3\log_{10})$$
$$t = -2.3RC(-1.0) = 2.3RC$$
$$Eq.\ (16)$$

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

$$0.1 = 1(1 - \epsilon^{-t/RC})$$
$$+0.9 = +\epsilon^{-t/RC}$$

Putting this into logarithmic form gives

$$\log_\epsilon 0.9 = -t/RC$$
$$-RC \log_\epsilon 0.9 = t = -2.3RC \log_{10} 0.9$$
$$t = -2.3RC(-1 + .9542) = 0.105RC$$
$$Eq.\ (17)$$

[1] See Appendix.

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

$$\text{Rise Time} = t_r = (2.3 - .105)RC$$
$$= \frac{2.2}{\omega} = \frac{2.2}{2\pi f}\left(\text{for } \omega = \frac{1}{RC}\right)$$

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

$$f = \frac{2.2}{2\pi t_r} = \frac{0.35}{t_r} \qquad Eq.\ (18)$$

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

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

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

Measuring Preamplifiers

In general, the test procedure and setup for measuring a preamplifier is identical to that shown in *Fig.* 4 One important exception must be considered.

A 16-ohm load has been placed at the output of the power amplifier. This is an extremely low impedance. Any normal capacitance due to instruments, such as the a.c. voltmeter, oscilloscope, distortion analyzer, and so on, is negligible.

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

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



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APPENDIX

Repeating *Eq. (14)*:

$$iR+\frac{1}{C}\int idt=e$$

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

$$iR+\frac{1}{C}\int idt=o \qquad Eq.\ (14A)$$

Assume $i=Ae^{pt}$ *Eq. (14B)*

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

$$iR+\frac{1}{C}\int Ae^{pt}=0$$

$$iR+\frac{1}{Cp}Ae^{pt}=0$$

$$iR+\frac{i}{Cp}=0 \qquad (for\ i=Ae^{pt})$$

$$i\left(R+\frac{1}{Cp}\right)=0$$

Solving for p results in

$$p=-\frac{1}{RC}$$

Substituting this into *Eq. (14B)* leaves as the solution for i

$$i=Ae^{-t/RC} \qquad Eq.\ (14C)$$

At the start of the impulse, all the current is across R. The current through the resistor at this instant is E/R. Writing this algebraically

$$i=Ae^{-0/RC}=A(1)=E/R$$

So that *Eq. (14C)* becomes

$$i=\frac{E}{R}e^{-t/RC} \qquad Eq.\ (14D)$$

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

$$e_c=\frac{1}{C}\int\frac{E}{R}e^{-t/RC}dt \qquad \left(for\ i=\frac{E}{R}e^{-t/RC}\right)$$

$$e_c=\frac{E}{CE}[-RC]e^{-t/RC}+Ee^{-t/RC}+A$$

Eq. (14E)

When $t=0$, $e_c=0$. At this time. *Eq. (14E)* becomes

$$0=-Ee^{-0/RC}+A=E+A$$
or $A=E$

Substituting this into *Eq. (14E)* yields

$$e_c=-Ee^{-t/RC}+E$$
or $e_c=E(1-e^{-t/RC})$

which is *Eq. (15)*.

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• **1962 MUSIC INDUSTRY TRADE SHOW ASSIGNS ENTIRE BUILDING TO ELECTRONIC PRODUCTS.** For the first time in the history of the show an entire building will be devoted to electronic products and their accessories. The 1962 show will be in New York June 24–28. Musical merchandise will be demonstrated at the Hotel New Yorker while the New York Trade Show building across the street will have five floors of exhibits devoted to sound reproduction equipment.

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



Irving B. Kahn (left), President of TelePrompter Corp., examines products of Weathers Industries, with Paul Weathers. TelePrompter has just announced acquisition of Weathers Industries.



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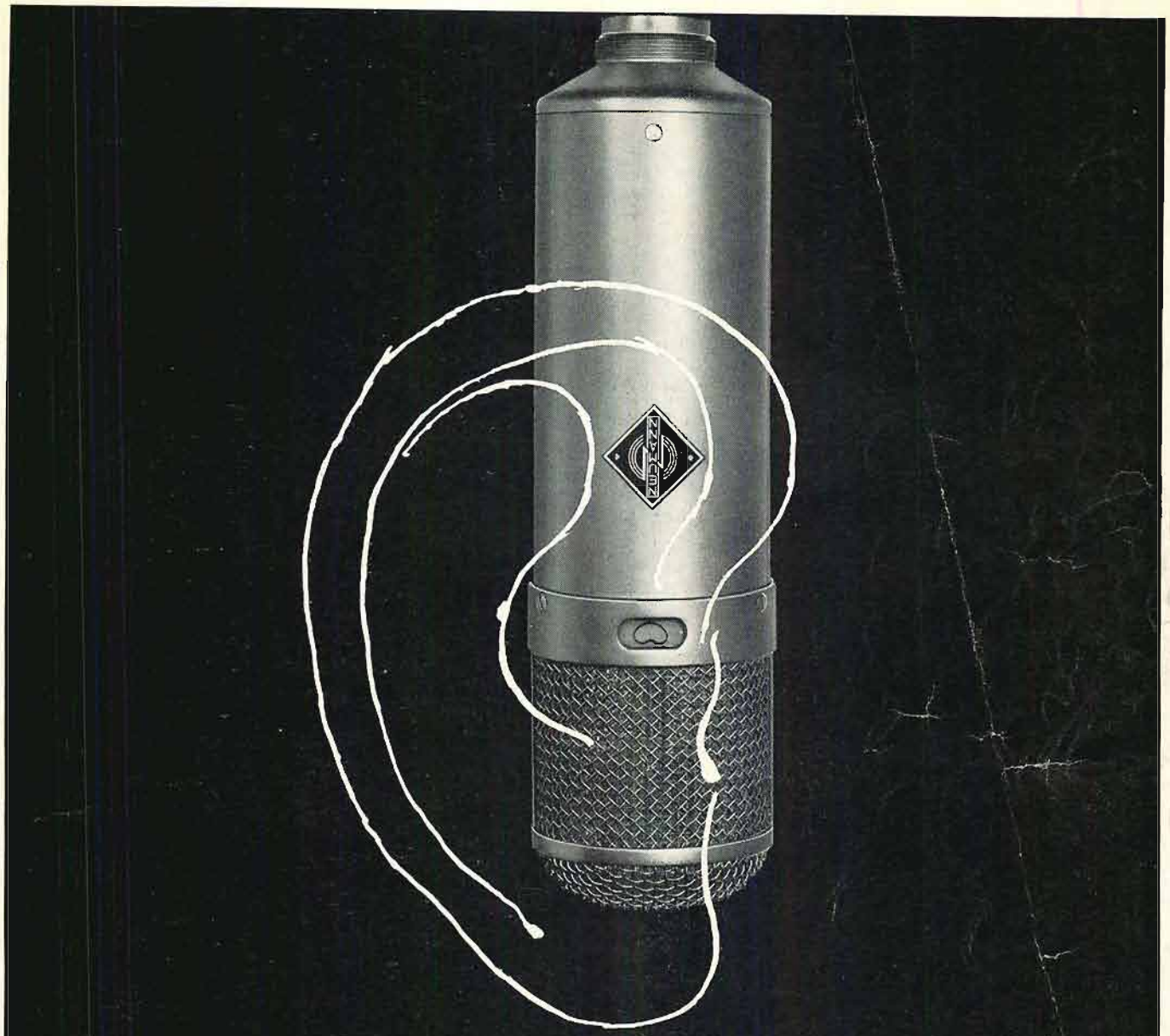
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