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SEPTEMBER/1964

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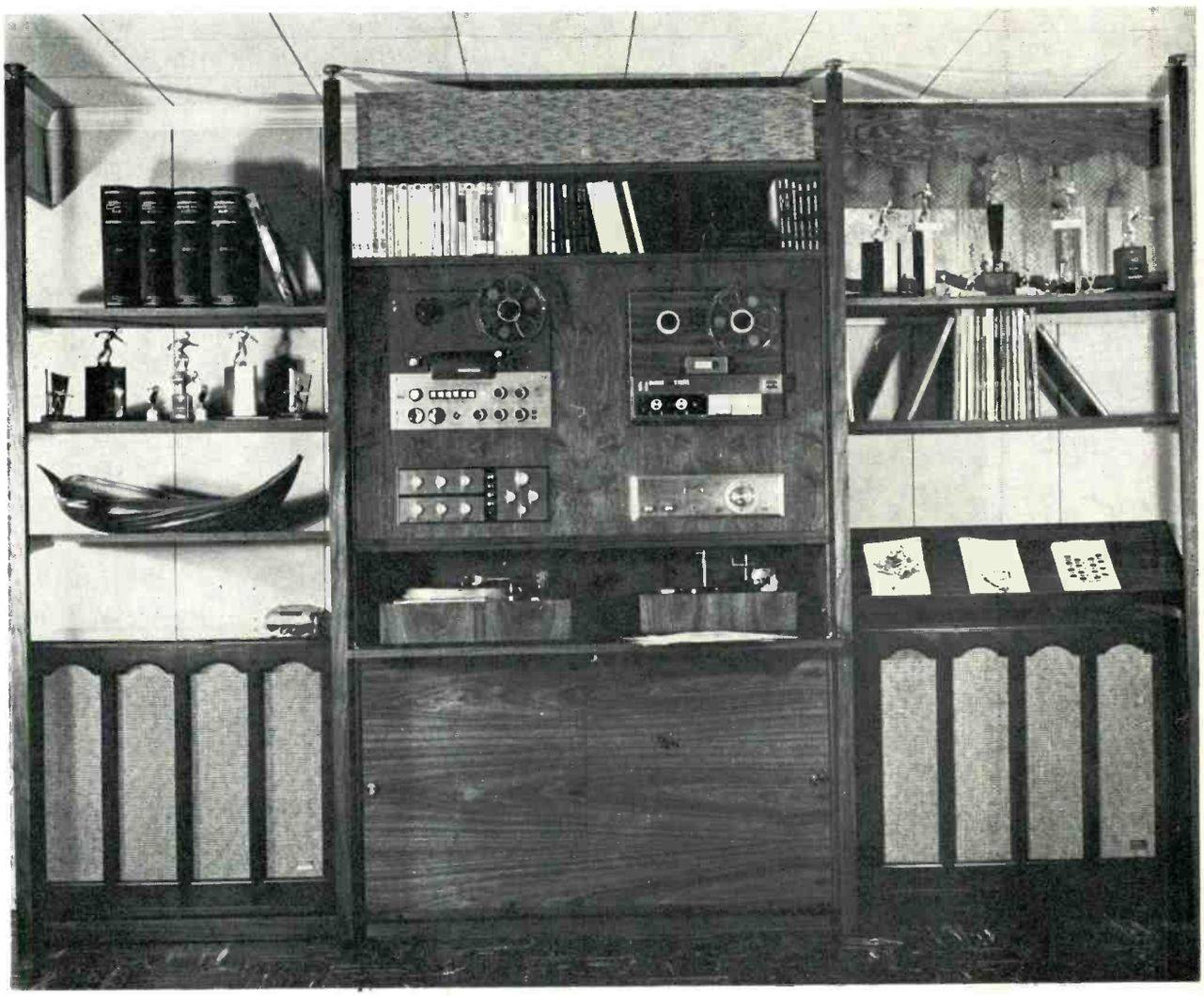

An off-the-wall unit with a custom look . . . . . page 69

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SEPT., 1964 VOL. 48, No. 9

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In the Oct. Issue

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AUDIO CLINIC

Joseph Giovanelli

Send questions to:
Joseph Giovanelli
2819 Newkirk Ave.
Brooklyn 26, N. Y.
Include stamped, self-addressed envelope.

A Stereo and Derived Center Channel System

Q. Since the directional effect of speakers occurs at frequencies above about 350 cps, I believe, would there be objection to using one (common) woofer for frequencies below 350 cps and two mid-high-frequency units for frequencies above. It seems to me that in this manner better frequency response could be obtained by using one good-quality woofer rather than two lesser units. My proposed wiring of such a system is shown in Fig. 1. Wiring for derivation of a center channel is shown in Fig. 2. The third, or center, channel could also be used for an extension speaker. C. J. Hill, San Francisco, California.

A. You certainly can obtain acceptable stereophonic sound reproduction using your scheme. (Your system is often used commercially.) The low- and high-frequency portions of your circuits would operate as you specify, by using a woofer common to both channels and separate high-frequency speakers to give the directional effect. I am not convinced, however, that the low frequencies contribute little or nothing to the stereophonic effect.

Further, you should be able to use the fourth speaker as a derived full-range center-channel speaker. (This is not a third channel because it is derived from the two existing channels. A third channel is present when three separate recorded sound tracks are used.) The impedance of the fourth speaker, however, cannot be higher than 8 ohms. The impedance of each of the other speakers, then, must not exceed 8 ohms. This speaker will probably reduce the output from your system.

One more point to keep in mind is that the woofer may be more or less efficient than the other speakers in your stereo array. If this does occur, you must compensate by limiting the output of the more efficient speakers with an L or T pad.

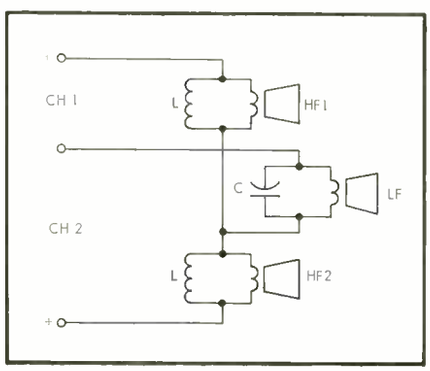

Fig. 1. Common-bass connections. L and C chosen for crossover at 350 cps.

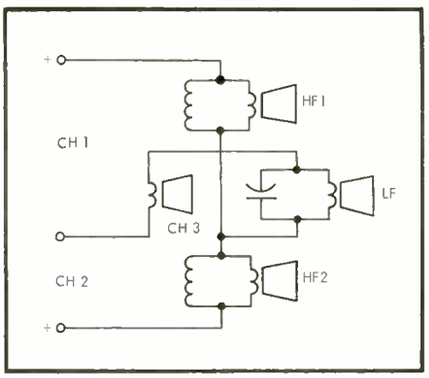

Fig. 2. Common-bass system with derived center channel.

Poor FM Tuner Performance

Q. My question concerns an FM tuner. I live in an area in which there are many powerful stations, and I have trouble with multipath distortion. To cure the distortion I bought a directional antenna and a rotator. With the antenna connected to the tuner, there is a great deal of background noise on strong stations. The noise is present on both monophonic and stereophonic reception, but is particularly apparent on stereo.

I constructed a 300-ohm balanced pad with a 5-db loss which helped somewhat. However, the pad reduces the signal strength too close to the threshold of limiting on weaker stations. Disconnecting one side of the antenna cures the noise problem, but also reduces the signal level, as well as destroying the directional characteristics of the antenna. Audio is clean except for the background noise. The noise is similar to interstation hiss, or white noise. Also, with the new antenna, the stronger stations splatter all over the dial. Some stations can be found as far away as 10 mc from their proper places. Other than the splattering, the tuner tracks properly. William A. Sasek, San Leandro, California.

A. The description of the sound produced by your tuner does not read like multipath distortion. The sound of multipath distortion is similar to a severe case of inner groove distortion on phonograph records. It is possible that your tuner is not operating properly or that it is simply incapable

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of good performance when subjected to strong signals. The "splattering" you have noted indicates that the front end of the instrument is overloaded or has insufficient selectivity to suppress spurious responses. Further, it is possible that the oscillator is "squegging" on strong signals. (This means that the oscillator, rather than producing its local signal at a steady rate, is oscillating for a portion of a cycle and then ceases oscillating for a period of time. The effects of this on receiver performance will be very similar to that which you have described. To cure this, you might check the oscillator grid bias resistor. If its value is too high, squegging will result.)

To be certain, obtain a tuner which you know is working properly. Connect this tuner to your antenna. Note its performance. If the second tuner performs poorly, you probably do have some multipath trouble in addition to the front end trouble with your own tuner.

It is possible that your location is very close to the FM station you wish to hear. If that is true, possibly the tuner is not as much to blame as I suspect. The directional antenna will then introduce a tremendous amount of signal into the tuner. This signal will overload the tuner. Tuners which do not provide age to their front ends are especially susceptible to this kind of trouble.

There has been a considerable rise in popularity in the use of superregenerative receivers, both for the Citizen's Radio Service, and for the Amatuer Radio Service. Such receivers radiate a wide spectrum of energy for a block or more. This radiated energy sounds very much like white noise. This, then, may be the source of your background noise.

Try adjusting your antenna for best signal quality, rather than for maximum signal strength. If your trouble is caused by front-end overload, reducing the signal strength will relieve it, assuming that repositioning of the antenna does not introduce multipath distortion.

If it often happens that you wish to listen to weak stations, discard the 300-ohm balanced pad you discussed in your letter. The purpose of the pad was to reduce the strength of local signals, but, as has been indicated, this same effect can be produced by rotating the antenna away from the desired signal.

To obtain the weakest possible signal, the antenna should be rotated 90 degrees from the direction of maximum signal strength. If the antenna is rotated 180 degrees from maximum signal strength, the signal will build up once again, but the strength of this signal will be considerably less than when the front of the array is pointing to the transmitting station.

(*Continued on page 55*)

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LETTERS

"Simplicity" Color Code

SIR:

"Ticky Tacky Wires," indeed! Cable and wire color-coding is simplicity itself, if cable and wire people would only adopt Ma Bell's standards, which have been in the public domain for years. All you need remember are five colors: Blue, Orange, Green, Brown, Slate. Numbers one to five. Number 6 becomes B-White, 7 is B-O, 8 is B-G, 9 is B-Brown, 10 B-Slate. Then it starts all over again: O-W, O-G, O-S: G-W, G-Br, G-S: Br-W, Br-S, and number 20 is Slate-White. *Pairs* 1 to 20 have white mates, 21-40 have Red Mates, 41-60 have Black Mates, and so on. *Single* Conductors are either plain (colors only), or have Red, Black, or white "novelty" (sort of a dotted effect) tracers.

What can be simpler?

By using the basic 20 color combinations and bundling the conductors into 20 pair complements (or singles) with a light wrap of colored cord, 20 x 20 pairs are possible in a single cable without any problems in locating *any* pair. (First 20 in Blue wrap, 2nd 20 in Orange wrap, so on). You simply cannot beat this system of color-coding wires. The only puzzling thing to me is the idiotic and non-standard assorted systems that most wire manufacturers use. No two systems alike.

Another Bell System standard we might adopt is "RED-Ring-RIGHT." In inside wiring, (R-G-Y) Red is the Ring side, Green, Tip, and Yellow is ground. I mark Right side cables with red fingernail polish —Red, RIGHT. The unmarked cable is Left (taped to the R side cable). Dots of model airplane dope, according to the WE color code, mark cables for their destination, numbered in order. Blue-number 1, Or-number 2, and so on. Red dot or plug skirt is the right side. You can't get much simpler than that!

FREDERICK C. HERVEY
Supervisor, WHKW
Rt 3 (Quinney Rd)
Chilton, Wisconsin

(Maybe we can't get simpler for telephone repairmen—but we had better get much simpler for music system users. ED.*)*

No Name—No Sound

SIR:

I read the editorial "No Name—No Sound" with considerable interest. I believe editorials of this kind are in the best interest of our industry as a whole, consumer—manufacturer—dealer publications included.

R. V. PEPE, Vice President
JBL International
3249 Casitas Ave.
Los Angeles 39, Calif.

SIR:

I'm very happy to see publications take a definite stand on subjects of controversy. Only in this way can the consumer—through the knowledgeable person—get the true facts on any product, as well as get the word on a sham product. I extend University's heartiest congratulations.

CHARLES W. OVERSTREET
Advertising Manager
LTV University
9500 West Reno
Oklahoma City, Okla.

Pike Disputes Electronic Shaver

SIR:

Certain points in Mr. Shaver's letter are worth answering, though the discussion provoked by my paper must, one hopes, end sometime.

First, there is no reverberation system on my organ, though I have long contemplated concocting one. There's little doubt that it would help, as the room is small (2300 cu. ft.) and relatively "dead." At least one commercial installation of an electronic reverberation system has been made by the Aeolian-Skinner organ company to improve the sound of one of their pipe organs which suffered from a particularly non-reverberant environment. From all reports it is eminently satisfactory.

For practice purposes, however, a "dead" room is not without its uses. Each faulty trill, rhythmic defect or finger slip is mercilessly revealed and when one has learned to play a given work convincingly under these circumstances, playing it on a different organ in a more reverberant environment is appreciably easier. Like spinach, it's good for one.

There are many who would not dub me a purist. For example, I dislike two of the currently fashionable (in some circles) fads intensely: tracker action and "chiff." Though most electronics do indeed sound better than harmoniums they do not, as a rule, sound better than pipe organs. In fairness to the electronics, however, I must report that I have heard two installations which were indistinguishable from excellent pipe organs. Both were expensive instruments with many ranks of oscillators. If this be heresy make the most of it.

Third, I did not mean to say or imply that "the imperfections such as the finite time it takes for a pipe to speak" are virtues. My point was and is that these characteristics inherent in the pipe organ are ignored in many electronics—one of the reasons why the latter sound different.

Last, I fail to follow the reasoning behind Mr. Shaver's statement: "if we carried his 45 different attack time to its logical conclusion we would go back—to a completely pneumatic pipe organ with no relays." What have the relays got to do with all this? In general the type of action used in a pipe organ, while in some cases (tubular pneumatic action) having delays of its own, does not affect the actual pipe attack times nearly as much as other factors (wind pressure, nicking, foot hole size, lip and languid adjustment). Aside from these technicalities, differing attack times as functions of pitch and timbre seem to be virtually immutable natural phenomena. Low-pitched pipes always start more slowly than high-pitched pipes. Pipes of certain classes of tone are consistently characterized by a different range of attack times than those of other classes. In the best electronics these naturally occurring relationships are deliberately preserved by appropriate (and expensive) circuit design. In the cheaper electronics this cannot be done for purely economic reasons.

WINTHROP S. PIKE
101 Leabrook Lane
Princeton, N. J.

WE DARE TO COMPARE THE CONCERTONE 800

FEATURES:	AMPEX 2070	CONCERTONE 800	CONCORD 884	EICO RP-100 WIRED	FREEMAN 200	NORELCO 401	REVERE M-2	ROBERTS 400D	SONY 500	TANDBERG 64	V-M 740	WEBCOR EP-2360	VIKING 220
6 HEADS	No	Yes	No	No	No	No	No	No	No	No	No	No	No
3 MOTORS	No	Yes	No	Yes	Yes	No	No	Yes	No	No	No	No	Yes
AUTOMATIC REVERSING FOR RECORD & PLAY	No	Yes	No	No	No	No	No	No	No	No	No	No	No
PUSH BUTTON CONTROLS	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
REMOTE CONTROLLABLE	No	Yes	No	No	No	No	No	Yes	No	No	No	No	Yes
SOUND ON SOUND	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BUILT-IN ECHO CONTROL	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No
CENTER CAPSTAN DRIVE	No	Yes	No	No	No	No	No	No	No	No	No	No	No
TRANSISTORS	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes
TAPE LIFTERS	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	Yes
OPERATES BOTH HORIZONTAL & VERTICAL	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	No	No	Yes
COSTS UNDER $400	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No

One look at the chart above should prove to your satisfaction that the Concertone 800 is your best value in stereo recorders!

What the chart does not show you is that Concertone's industry exclusives — double Reverse-o-matic® (automatic reversing at each end of the tape), and six heads — combine to give you continuous music playback and recording with the touch of a button.

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CONCERTONE

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LIGHT LISTENING

Chester Santon

Frederick Fennell: Broadway Marches
Mercury SR 90390

This recording is part of Mercury's fall release schedule but it was a warm evening in early summer when I attended one of the three recording sessions that brought it into being. The invitation to visit Bob Fine's recording studio in a former ballroom of New York's Great Northern Hotel had been extended by my colleague in these pages—Harold Lawrence—in his non-spare time a recording director for Mercury Records. Frederick Fennell's latest recording session had on its agenda a program of marches from leading Broadway musicals to be played by a sizable group of top instrumentalists taken from New York's pool of free-lance recording musicians. The orchestra (no strings but heavy in brass, winds and percussion) was spread out in a thin semicircle that filled one half of the converted ballroom. Although lower in ceiling than most ballrooms of its size, the studio at the Great Northern is a very live one. Therein lies the saving grace in a session that exceeded any other I've attended in closeness of miking. Gradual changes in the other links in the stereo disc recording process now permit proximity in mike placement that would have been out of the question a few years ago. Just about every instrument at this Fennell session had its own Telefunken or RCA 44 boomed above it at a distance of only two or three feet. The condensers were on winds, accordion, banjo, guitar and percussion with the ribbons assigned to the special problems generally created by trumpets and trombones at so short a distance. As at most sessions run by a practical crew, the criterion for determining the best sound of the orchestra was the playback of the master tape as soon as a satisfactory take had been completed. Since recording engineer George Piros was driving the three Altec monitor speakers at full volume during each take, the slightly lower signal level in tape playback (coupled with tape's normal attenuation above 15 kc) gave a more realistic picture of the orchestra than did the live monitoring. From my vantage point just to the right of the recording director it was easy to see that one source of tension for the recording engineer had been eliminated in today's sessions. The three VU meters were allowed to peak at some distance above the once-sacred zero mark.

Some weeks after the event, Harold Lawrence made available to me test pressings derived from the session for evaluation on my own equipment. Stereo separation is more pronounced on my home setup than it appeared in the control room. Test pressings having a slightly better high-end response than the commercial product, the sound on disc is remarkably close to my memory of the master tape playback. As for the contents of the album, seekers of the conventional in show tune arrangements are advised to look elsewhere. In many of the selections, this recording is a pretty uninhibited affair. Ranging over a wide span of Broadway musicals, the album has many highlights: a rousing version of Gershwin's *Strike Up the Band* with generous quotations from the band literature, a steamboat whistle and pistol shots during a Stephen Foster medley and a truly unbuttoned treatment of *Nothing Like A Dame* from "South Pacific." The best sound by the full orchestra is found in *76 Trombones* while top audio honors go to the percussion section in *The March of the Siamese Children*.

Fade Out—Fade In (Original Broadway Cast)
ABC-Paramount OC 3

ABC is really rolling ahead in what appears to be a major invasion of Broadway show recordings. Hard on the heels of its excellent "High Spirits" original cast album, ABC-Paramount scores again with this tribute to the Hollywood musicals of the 1930's. Just as Beatrice Lillie stole the "High Spirits" album, Carol Burnett corrals most of the honors (comic as well as musical) in "Fade Out—Fade In." She's got a lot to work with in fine songs by Jule Styne and biting lyrics by Betty Comden and Adolf Green. Years of television appearances have not dulled Miss Burnett's appetite for zesty material and zesty material is precisely what she's blessed with throughout this enjoyable musical. It is hardly necessary to remind TV fans that no department of comedy holds terrors or problems for Carol Burnett. Her conquests in this field belie the fact that her first New York appearance was made only five years ago in the musical "Once Upon a Mattress." In her latest mainstem musical, Carol Burnett plays the part of an ex-movie usher who is catapulted to stardom in the wacky world of an earlier Hollywood. A solid succession of songs (*The Usher from the Mezzanine* and *Lila Tremaine*), delivered with verve and comic ingenuity by Miss Burnett, chronicle the transformation of Hope Springfield into the glamorous Lila Tremaine. *Call Me Savage* and a poignant *Go Home Train* add to the Burnett laurels. Jack Cassidy, one of the busiest actors of the past season, is a reliable foil as her leading man. The broadest slice of comedy in the show is the Burnett song and dance impersonation of Shirley Temple in the deadpan lyrics of *You Mustn't Be Discouraged*. Add to all this the bonus of truly outstanding audio work and you have a very nice record on your hands.

Skitch Henderson
Bronjo BR 105

Prominent pianists in the light music field are turning up in the most unexpected places these days. Did you know, prior to scanning the top of this review, that Skitch Henderson is now recording for the Bronjo label, a division of Seeco Records? Connoiseurs of truly tasteful piano work will find this release worth all the effort involved in searching for it. The dozen selections are split three ways for top tunes by Cole Porter, Richard Rodgers and Jerome Kern. The pressing is a noisy one at anything approaching normal volume yet the performance by Henderson and his small combo can be recommended to the hilt for low-level, late evening listening.

World's Fair Suite
RCA Victor LSC 2764

Ferde Grofe's "World's Fair Suite" is now available in its official recording with noted bandmaster Paul Lavalle leading the World's Fair Symphony Orchestra. Its five sections attempt to capture, in familiar Grofe style, such features of the Fair as the Unisphere, the International section, the industrial pavilions and the merriment originally planned for the Amusement area back in 1961 when World's Fair President Robert Moses invited Grofe to tackle the assignment. The music Grofe Suites such as "Grand Canyon" or cannot be mentioned in the same breath with others but it will do as a souvenir of the fair.

Weill Classics: Lady in the Dark/Down in the Valley
RCA Victor LPV 503

It would seem that Columbia Records' recent decision to renew our acquaintance of Kurt Weill's "Lady in the Dark" with a modern recording has reminded RCA that the vaults have contained music recorded many years ago by the show's original leading lady. Where Columbia tried to revive memories of the 1941 production through the fine voice of Rise Stevens, RCA bolsters its newly-announced Vintage series with the voice of Gertrude Lawrence heard in the part she created when the show opened on Broadway. The historic value of this RCA theater recording cannot be questioned but the reissue is no more than a sampling of the score as compared to Columbia's revival of "Lady in the Dark." The Rise Stevens production takes up both sides of the record, offering a comprehensive coverage of the music by the principal members of the cast. This RCA reissue, occupying but one side of the disc, is devoted almost entirely to Miss Lawrence's songs. The sound is antiquated but not quite enough to bother anyone really curious to hear the original concept of a musical role that broke with theatrical tradition.

"Down in the Valley," Kurt Weill's one-act opera based on familiar American folk songs, takes up the rest of the disc and features the cast that presented the work as the first opera to be telecast on the NBC Opera Theatre, January 14, 1950. Since the recording was made only eleven days after the telecast, the sound on this side of the disc is far superior to that of "Lady in the Dark."

The Great Isham Jones and his Orchestra
RCA Victor LPV 504

The next time you happen to find yourself arguing that the years of the Thirties were the golden days of the big dance bands whip out this exceptionally fine reissue in RCA's new Vintage Series. Just about everything you'll require to make your point can be found in these solid arrangements by the famous Isham Jones and his orchestra. The Jones band was a rather unique institution in dance circles from 1919 to the mid-1930's. Before joining the Victor label, Isham Jones was one of the big attractions of the old Brunswick Record Company. (By 1923 he had received over $500,000 in royalties from Brunswick.) Not only did Jones write over 200 songs, many of them still in use today—he was the first to sense that "Stardust" would make a fine ballad some two years after it emerged on the music scene as a wordless bit of ragtime. Anyone who listened to the great radio bands on the receivers of the day will certainly appreciate RCA's gesture in reissuing on LP the Isham Jones 78's that had been stashed away in their vaults. Here, in surprising good sound, is a chance to relive the days when Chicago was the home base of dance bands such as Hal Kemp, Bob Crosby and the Coon-Sanders group. The selections presented here cover a period of twenty-three months (August 17, 1932 to July 16, 1934) and include sides from Isham Jones' first and last RCA Victor recording sessions. I find them a very pleasant way to relive history.

Martha Schlamme/Will Holt: Kurt Weill Cabaret
M-G-M SE 4180

This is a generous sampling of the off-Broadway cabaret performance that made such a hit with Kurt Weill fans when it opened last year just off the Bowery. In the stage production, a beat-up gilt piano and two dusty bar stools were the main props as Martha Schlamme and Will Holt introduced and sang excerpts from famous as well as lesser known Weill shows. The extensive folk music background of both singers is a great advantage when it comes to recreating for the home listener the period of pre-World War One Germany that Weill mirrored so uncannily in his biting songs. For a native of Portland, Maine, Holt does an effective job of keeping up with Miss Schlamme who, of course, has the advantage of Austrian birth in breathing life into these highly European creations.

Before multiplex came along, you could get by with an average tuner.

Now you need a Fisher.

The new, transistorized Fisher TFM-300.
Size: 15⅛" wide, 4 13/16" high, 11⅞" deep. Weight: 9 lbs. Price: $299.50.

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Even though FM-stereo has potentially much greater sonic realism than FM-mono, a multiplex broadcast can actually sound badly distorted unless received through an absolutely first-rate tuner. And to hear a stereo program *exactly* as it was monitored in the FM station's control room requires the sensitivity, wide-band design, low distortion and unequaled channel separation of a Fisher multiplex tuner. Nothing less will do; the medium itself has become more demanding.

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Norrie Paramor: In London . . . In Love Again

Capitol ST 2071

Norrie Paramor hasn't had an easy time establishing a reputation in this country because the leading record catalog doesn't list him in the section where most record buyers would normally look for a popular orchestra. His group has been held in high regard by knowing collectors since 1956 yet the outfit is not listed in the "Popular" section of the catalog. Instead, Paramor pays a price for the authenticity of his English style of music making by being listed solely in the catalog section marked "Popular—Other Countries." There, under the "England" heading, he occupies the most prominent listing with nine releases, along with Ray Noble, Jack Hylton, Frank Cordell and such esoteric phenomena as the "Original Soho Skiffle Group." The Paramor strings, aided by an unusually full-throated piano, happen to be one of the very rare ensembles to merit the use of the word luxuriant in describing their sound. What's more, the exceptional nature of the sound is on this disc where an expensive system can actually make use of it. The selection of music in this recording is in a class with the sound, giving Capitol a stereo disc that any company interested in quality would be proud to call its own.

America, I Hear You Singing

Reprise FS 2020

Where once the Reprise outfit was content to launch a record merely on the talents of an individual star, it has lined up a pretty impressive cast for one of its latest projects. The title of this album has perhaps already told you that this is one of those Be-Glad-You're-An-American epics featuring the kind of music you are apt to hear when a travelog film on the U.S.A. reaches its climatic moment. Reprise comes up with the predictable stuff for chorus and orchestra. The surprise is in the choice of featured performers. To keep the business from getting too pumpous, Bing Crosby and Frank Sinatra are starred in the solo positions with Fred Waring's organization bringing up the heavy artillery. Seven arrangers were brought into the undertaking to lend diversity to typical Americana such as *The Hills of Home, This Land is Your Land* and *Stars and Stripes Forever*. The combination of talent should find a ready market, even among those who don't normally make an effusive display of their patriotism.

Richard Tucker: Vienna, City of My Dreams

Columbia MS 6537

One can sympathize with Columbia's efforts to bring the glories of Viennese operetta to an English speaking audience and still be less than excited about the results. Richard Tucker's latest album turns out to be a handsome and comprehensive collection of tunes, many of them usually found only in the record libraries of the operetta connoisseur. Two things stand in the way of unreserved enjoyment of these delights of the Viennese stage of decades ago. The English lyrics concocted by Merl Puffer and Deena Cavalieri (they supplied the libretto for the recent Columbia recording of "The Merry Widow") are one problem. The other is the somewhat stodgy approach to this gay music by Richard Tucker. In ten of the thirteen selections recorded here, the team of Puffer and Cavalieri has supplied new translations that demonstrate once more the virtual impossibility of translating the gossamer magic of the original lyrics into our own tongue. Under these circumstances, it's hardly Tucker's fault that he occasionally sounds more like an oratorio tenor than an operetta star. If you consider the degree of fluid ease Tucker still manages to bring to the immortal tunes of Lehar, Zeller, Von Suppe and Strauss in these stiff translations, it's a pity Columbia didn't assign him the original lyrics for his first Viennese album. The Columbia Symphony under Franz Allers lends velvety support to the rich Tucker voice but the conductor finds it no easier to handle some of the more awkward phrases than the singer does.

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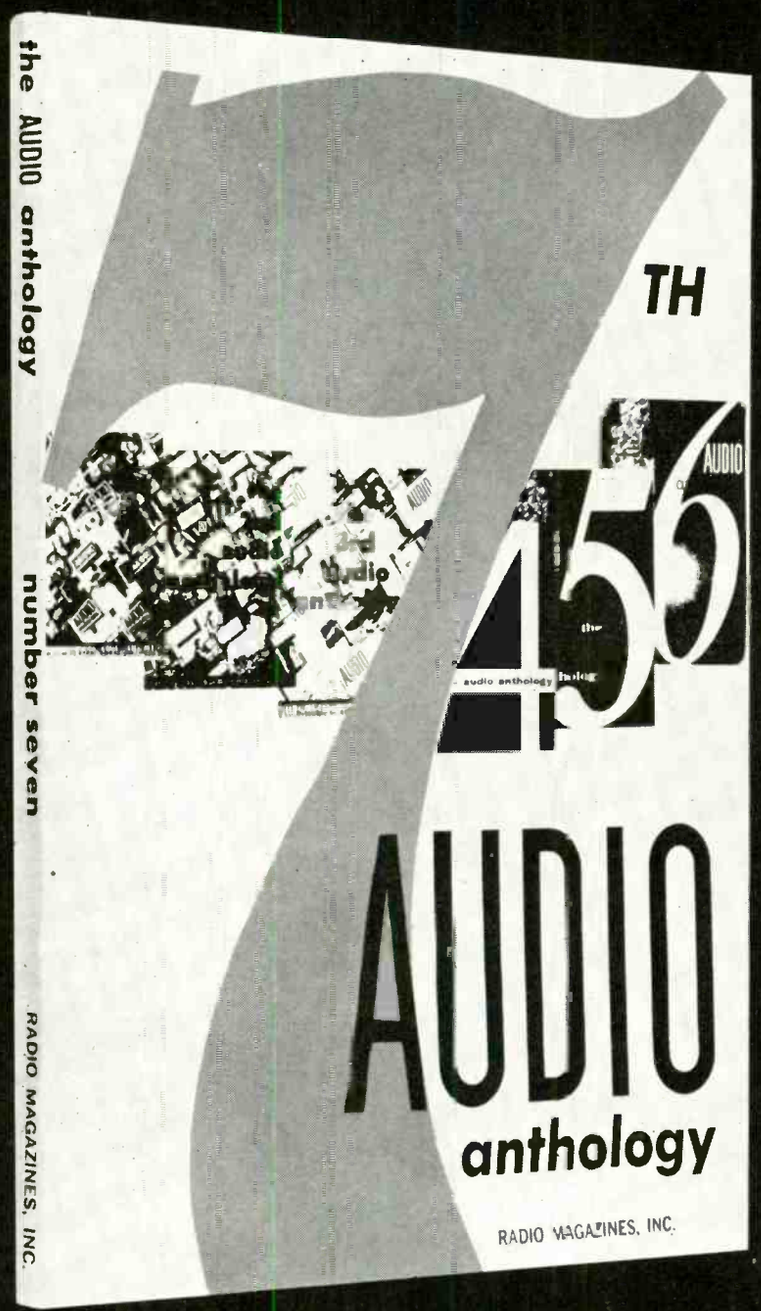

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AUDIO ETC.

Edward Tatnall Canby

HANDLERY

It's a strange and rather pleasant feeling, as I hit the typewriter once more, not to have a single audio-idea in my large, empty head. That's what comes of time-off in this business—the so-called double-sabbatical (plus three) that I've been taking from this column. It would have had its seventeenth anniversary this last May, if I had been there.

Yep, I've been absent, though some of our readers haven't yet noticed it, I gather. Nigh-onto five months. Nope, I did *not* have a heart attack and hereby serve notice that I wish no more condolences and expressions of sympathy, thanks-just-the-same! Look closely (AUDIO, June 1964, p. 12) and you'll discover that it was Norman Pickering, founder of the great Pickering phono cartridge enterprises, who had the heart attack and was, happily, recovered enough to write a June guest column for us. Some of our more determined readers insist on crediting me with Mr. Pickering's misfortune, as well as his excellent article.

Yep, I did write the repeat columns, in May and July. That is, I originally wrote them, so to speak. And if some happy readers took as 1964 gospel all those things I said about small record companies, as of a number of years ago (AUDIO, May 1964)—then I must be getting infallible or something. I found the piece interesting to look at again mainly because so much has changed since then. More on *that* subject later on, I hope.

Oh yes—that "Audio Year" (our July issue. It wasn't *this* year I was describing. It was the 1953–54 audio year, as of ten years ago. Wonder how many people noticed, as they read?

So here I am, live and current, writing once more in '64, and what is most interesting to me about my own reactions to no-audio for these months is my slipping memory. Memory, that is, for incidentals. Details, How soon they fade!

Fphlop-B

Oh I remember the big principles, all right. But I tend to forget the handles. We get so awash with handles in our business, it's a wonder anybody has time for the fundamentals, though plenty seem to.

You see, people keep right on writing me every so often for hi-fi advice because I'm a "hi-fi expert" in some people's minds, if not my own. And in true hobbyist fashion these people prefer to talk the lingo. My correspondents take pride in revealing to me their own knowledge of what it takes to be a hi-fi man. They know all about current audio terminology and I'm duly impressed, you may be sure. I don't stand a prayer of keeping up with them, myself.

Dear Mr. Canby, someone will write (to concoct a concentrated example), I am about to assemble a high fidelity system. (*Oh yeah? You said that the last time.*) I would like your advise. (*For some reason, that is the usual spelling.*)

My present system consists of (*oh-oh—here come the handles . . .*) an AQZX-2 in a BGXBT arm and a SQWK Super De Luxe feeding a SAP-3 and a FPHLOP-B Mark II, 50-50, into a pair of XYZ 4Cs. (*Humph, say I, that last must be speakers.*) I use the SKRCH II, Mark XXVI, with a GLRP 29BX array. (*Ah yes, antenna I suppose. I'm groping for clues.*) The FPHLOP-B also feeds a Coronet DXLYMPNX Rondo Sonata Superbo. (*A tape recorder, maybe? There isn't much else left.*)

I would like your advise, the letter continues. Please give me your opinion on the exact performance of the AZ-3, the Whillow, the Whssp, the Major, the Corporation, the Baron, the President. Also the Emperor III and Whomp Mark V, also the Tweet, Jr. Also the speakers in the following list see pp. 2–4.

Also please specify the tube radiation curves for the FPHLOP-B as compared to the FPHLOP-D also the MNXX 29. I would like your opinion. (*On what, for goodness' sake??*)

At that point, my head reeling, I dig out the audio catalogues. Hmmm. . . . (while my secretary waits with all her usual patience); here's the FPHLOP-D all right. It *was* an amplifier. Guess my hunch wasn't so bad. No tube info. All transistors, maybe? It says 20–20,000; this must be an old catalogue. This year it's 0–1,000,000, isn't it?

The letter isn't over yet. I have decided, it says, to replace my FPHLOP-B with an MNXX 29 and the AQZX-3 in the Gyrogymbal 2A-3 into EX 99s. I have already ordered these. I would like your opinion. I would appreciate your help in choosing my high fidelity system. Thank you for your advise. Sincerely, Joe Doe.

Thanks for nothing, friend, I mutter as I breathe a sigh of relief. It's not merely that our fond readers tend to ask us for advise (sic) when their minds are already made up—or they don't intend to do a thing except on paper. That is an excusable enthusiasm, a normal pipe-dreaming, an understandable wishful-think! I do it myself with my new car, every two months by the calendar; and I still have my '62 VW117, natch. One has to plan. One must have advise, after all.

No—what gets me, after five months of no-audio, is the handlery. I just can't seem to remember whether it's the Jensen PAS-3 or the Dyna TF-4. Was it the Sherwood S8000III, or maybe the Harmon-Kardan? I mean Karmon II—. Wait a sec; That must be HarMAN KarDON. Keerect!

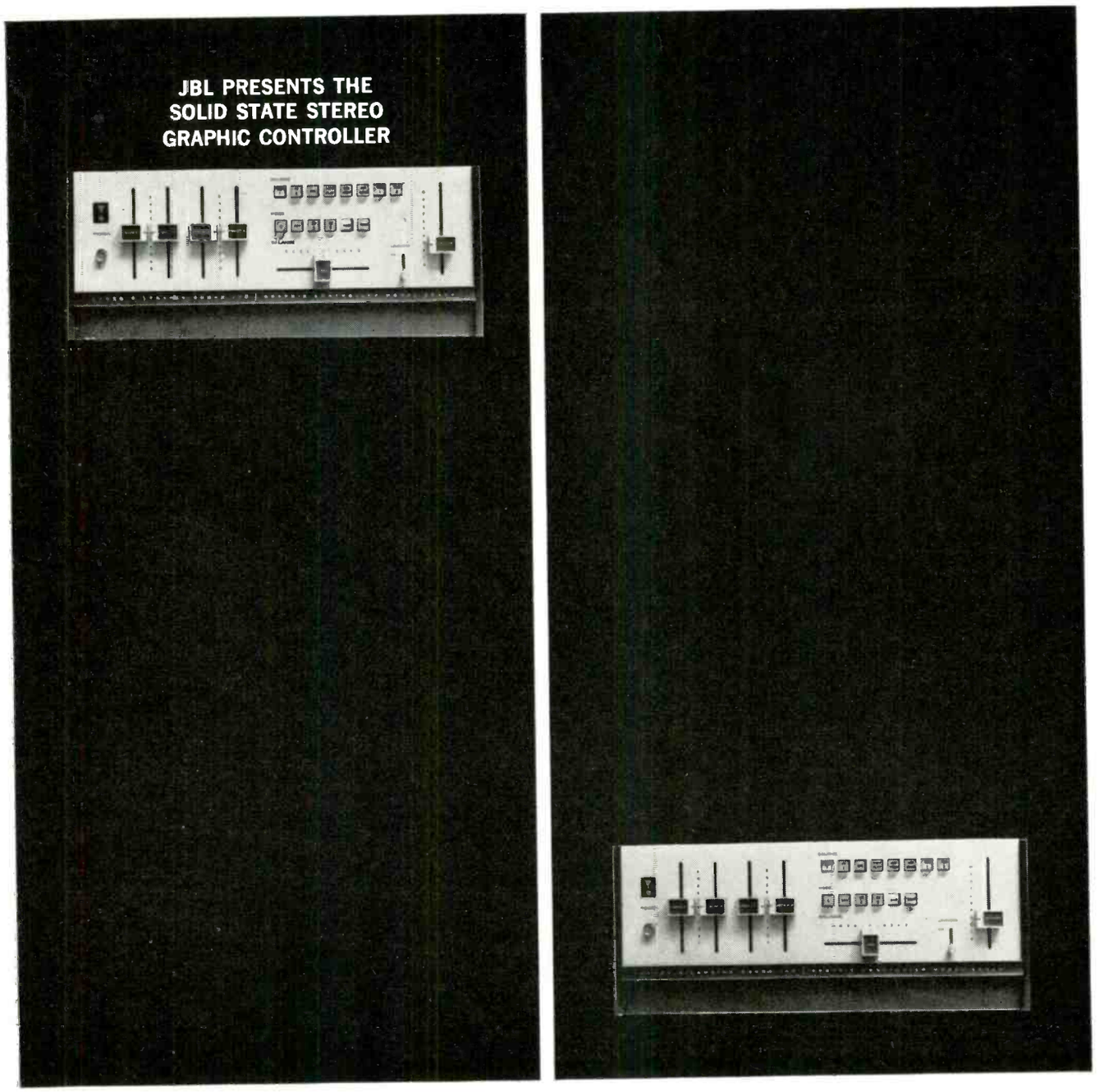
And how about the TA700X? Doesn't seem to ring the right bell with me, somehow. Or the X-101-C. Who belongs to that one? I'm stumped. Nor can I figure out the who or what of the 380, the 222D and the 333B, the 654MA. Not even the MR67. (That one sounds like "Mister Audio of 1967." But what *is* it?) Definitely, I can't figure the D51-001-2E/T. Took a master mind to concoct that.

I couldn't figure these out, that is, if I hadn't just taken every one of them straight from a genuine hi fi catalogue. They're for real. Nope. I don't have that kind of memory.

(If I did, you see, there are all those phone numbers and zip codes by which I must identify not a mere piece of audio equipment but MYSELF. Area codes and audio too? It's just too much. Even minus a dog tag I must keep in mind that I'm known on the long-distance wire as 2030R26085, or 1212CII36283, zip code 06796 or 10014, as the case may be. And don't even ask me my several multi-digit bank account numbers. Or my social security. That one, at least, is firmly on file in the AUDIO office.)

So there you are. After five months of absence, nothing in my head but figures and letters, hopelessly jumbled. Not even a suggestion as to what we might do to unhinge this alphabet soup of audio-terminology.

Forget it all? That's just what I did. But, luckily for me, all the new 1965 catalogues have just arrived (06796). So if you'll pardon me, I'll go quick and bury my head in the sand. . . . D—it, I mean *in the catalogues!* That's what I said, didn't I? Æ



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ABOUT MUSIC

Harold Lawrence

"Assisted Resonance"—A Revolution In Acoustical Design

Around 330 B. C. Aristoxenus of Tarantum, a pupil of Aristotle and a musical theorist, developed a new system of sound reinforcement for amphitheatres which involved the use of tuned vases built into the walls. Two thousand years later, a group of English acousticians, frustrated in their attempts to cure the sonic ills of London's Royal Festival Hall, remembered this ancient Greek acoustical remedy. Adding a dash of electronics to the original brew, they called theirs "assisted resonance." If successful, this blending of electronic amplification and resonators could have a profound effect on the future of concert hall acoustics.

The news about Royal Festival Hall's "assisted resonance" broke this spring when the hall's General Manager, T. E. Bean, revealed that experiments had been conducted there during rehearsals and concerts on thirty separate occasions. Apart from a few technicians and selected guests, the public had been kept in the dark about the work of the acousticians. Reaction to the experiments ranged from vague uneasiness to unqualified approval: conductor Sir John Barbirolli found the hall "warmer," some orchestral players found they were "getting more response" from the auditorium, and critic Harold Schonberg was conscious of a "smoothness, richness and instrumental fusion that definitely puts the Festival Hall into a superior class." Others feared the consequences of the introduction of electronics in the concert hall.

Bean himself was appalled at the idea of assisted resonance when it was first suggested to the management of Royal Festival Hall. "It seemed to us to imply practices which we felt certain would be anathema to the performing musicians and to the discriminating listener alike . . . It conjured up the [picture] of a 'sound engineer' crouching anonymously back-stage over some high-fidelity control panel, monkeying with the balance, adding brightness to whiteness, and impudently 'improving' on the amateur efforts of Klemperer or Menuhin." But after the acousticians of the Building Research Station had cornered him and outlined their proposals in greater detail, Bean finally gave the project his cautious endorsement. During the past two years, his mood changed from skepticism to guarded optimism.

I set out to visit Bean on a rare sunny day in London early this summer. Dodging cranes, bulldozers and construction gangs at work on the new halls emerging alongside the Royal Festival Hall, I reached the building in which Bean's office was located. A workman directed me down a long corridor to the "last door on the right." (The sign painters had not yet labelled the doors.) I entered a modest-sized office overlooking the Thames. Soon a gray-haired, bespectacled man walked briskly into the room, shuffled some papers on his desk, looked up and saw me standing near the window. "Hullo . . . What—er." I introduced myself and his puzzled expression instantly cleared: "Oh yes, I was expecting you. But how did you get in here? This is my inner sanctum; the reception room is down the hall . . . Was it the elevator operator? Oh well, we all get a bit confused at times with this construction going on."

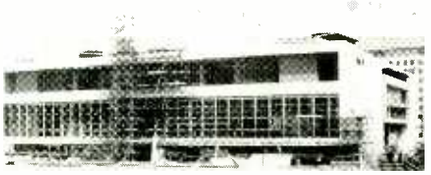


Fig. 1. Royal Festival Hall gets a face-lifting, July, 1964.

Bean, who has been General Manager of the Royal Festival Hall for the last dozen years, feels that the acousticians have at last taken a significant step toward improving the sound of this controversial hall. "From the day the Festival Hall opened in 1951 until the summer of 1962 we have been almost continuously investigating the possibility of increasing its warmth and resonance without sacrificing those positive virtues which have given the Hall its distinctive character; that is, its clarity, its comparative uniformity of acoustics and its freedom from echo.

"I mention the summer of 1962 because this marked an important landmark in these investigations. By that time we had become finally convinced that no effective lengthening of the hall's reverberation period could be looked for from any further treatment of its absorbent or reflecting surfaces. Or to put it another way, we were satisfied that any increase in reverberation which might result from such modifications would be so negligible as to be imperceptible to the human ear."

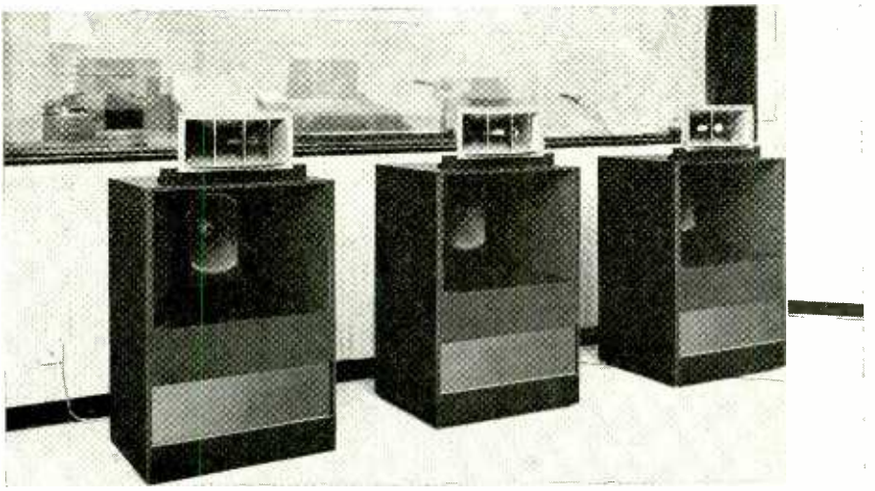
Rather than reduce the size of the audience, rip out the ceiling, or alter the shape of the building, the acoustical advisers decided to turn to electronics for help. However, they rejected traditional forms of sound reinforcement involving microphone pickups of the program source and amplification through loudspeaker systems. "Such a technique is bound to introduce noticeable distortion or coloration," stated William Allen, Hope Bagenal's successor at the Festival Hall. "It is virtually a re-broadcast, and, because it is usually controlled by an engineer, a variable human factor is also added, as in radio and recording, where of course it is necessary and great skill is brought to bear."

Bean stressed that the new system developed by Allen, Bagenal (original acoustical adviser to the Royal Festival Hall) and Peter Parkin "aims at restoring the acoustical energy where it is unavoidably absorbed by the surfaces of the hall and by the audience, *not at the source,* which would involve an inevitable falsification of tone, but in the body of the auditorium where the acoustical energy begins to disappear."

The "assisted resonance" system includes Helmholtz resonators, amplifiers, microphones and loudspeakers. The experiments began in June 1962 in a disused factory in Bethnal Green. Nearly two years later, "sufficient progress had been made in increasing the reverberation of the lower frequencies by assisted resonance to warrant the testing of the results under concert conditions in the Festival Hall itself," Bean related. 89 resonators were installed in the ceiling of the Festival Hall, each tuned to a specific frequency between 70 and 300 c.p.s. According to the hall's acousticians, the reverberation period has now been lengthened from 1.4 to 2.1 seconds in these lower frequencies.

Even before the disclosure of the new system, musicians had begun to comment on the mysterious changes in the hall's acoustics. Yehudi Menuhin spoke to Bean about the "remarkably warm quality of the strings and winds." Rafael Kubelik asked Bean: "What have you been doing with the acoustics? The sections of my orchestra blend better and the brass now has a more cohesive sound." Orchestral musicians seemed to feel that their ensemble playing had improved because of the acoustics. After the public

(*Continued on page 61*)



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EDITOR'S REVIEW

"ASSISTED RESONANCE": SINGLE-FREQUENCY REINFORCEMENT

THIS MONTH in ABOUT MUSIC, Mr. Lawrence discusses the interesting attempt to improve and control acoustics at Royal Festival Hall in England by means of a technique they call "assisted resonance." Last month our guest conductor of AUDIO ETC, Dr. Beranek, discussed the same topic in a somewhat larger framework. (By the way did anyone notice that the two illustrations in that column were reversed—the Moscow Hall was captioned Royal Festival Hall, and vice-versa?) Although some of the details are not yet clear, we do know that the system contains reinforcement for discrete frequencies rather than broad spectrum reinforcement. Thus, in the range from 70–300 cps, the present reinforcement range at Royal Festival Hall, there are 89 specific frequencies reinforced. Apparently that means 89 Helmholz resonators, 89 microphones, 89 amplifiers, and 89 speakers. And all this paraphanalia is in the hall proper rather than in the stage area. In fact the resonators are "buried" in the ceiling. This reinforces only the sound which would normally be reflected; in other words it increases reverberant energy.

This technique points the way towards a new concept of acoustics that may well revolutionize the entire field. To us the significant point here is the potential acceptance of electro-acoustics as a valid supplement to mechanical acoustics. Once it is understood that using electro-acoustic reinforcement is no more "unnatural" than using sculpture, decorated walls, and other physical objects as acoustic aids in concert halls, but rather is the modern way of doing similar things, then we will discover many new electro-acoustic solutions. For instance, we can visualize several ways to accomplish the same function as the "assisted resonance" technique, and perhaps more economically. We can visualize them now that the topic has been broached, now that the pioneers have opened the frontier.

A SHORT SABBATICAL

Usually, when a sabbatical is taken, it lasts for at least a year. That's custom, and probably the derivation of the name; one year off in seven. But nobody can accuse Ed Canby of doing things in the customary manner. Thus, when he felt the need for his sabbatical, earlier this year, we were quite resigned to expect the unexpected. We didn't know whether he would be sufficiently sabbated after one, two, three, or three hundred months. It's not that Mr. Canby is not reliable; after all he did meet a monthly deadline for 17 years, but rather that he has an original way of approaching things. Heaven knows where his originality may have taken him during this period. Fortunately for us, it has taken him right back to AUDIO ETC much sooner than we had dared hope. This month he resumes refreshed.

By the way, we must apologize, belatedly, for the mistaken impression created by one of the guest conductors; apparently a goodly number of people missed the name of the guest (Norman Pickering) and assumed that Mr. Canby had suffered a heart attack, rather than Mr. Pickering. Not a pleasant occurrence in any case, but rather disconcerting to have friends call and offer condolences when you are as healthy as Ed Canby is. We do apologize to those who assumed the worst, but after all, Mr. Pickering's name did head the column.

QUALITY CONTROL

Some months back we asked for your experiences with manufactured products insofar as quality control was concerned. Many readers wrote and detailed problems they had encountered with one manufacturer or another, but we were happy to note that there was no consistent pattern indicating that a particular manufacturer was falling down on the job.

The incidents that many readers reported must have been quite distressing, and certainly we are unhappy when we learn that a high fidelity manufacturer is not perfect, but after all who is?

We do thank all readers who took time out to let us know about their difficulties. Further, where possible, we have attempted to help in specific cases. Please feel free to write us if quality control seems to be a problem to you. We will try to help, of course, but more important we will keep a file to determine if a pattern starts to emerge some time in the future.

BLACK AND WHITE REVISITED

It seems rather soon to have to eat our words, but that is exactly what we will have to do. Last month we proclaimed the return of yellow paper stock for the Commercial Sound Course, this month we un-proclaim it. Unfortunately, production problems have ruled out the special paper again. In fact, according to our production people, it is almost impossible to do what we want to do. We can only say that what you saw in those first chapters was not yellow paper, but rather white paper turned yellow with frustration.

In any case, from now on we proclaim nothing, and perhaps the impossible will be done again.

SHOWS, SHOWS, SHOWS

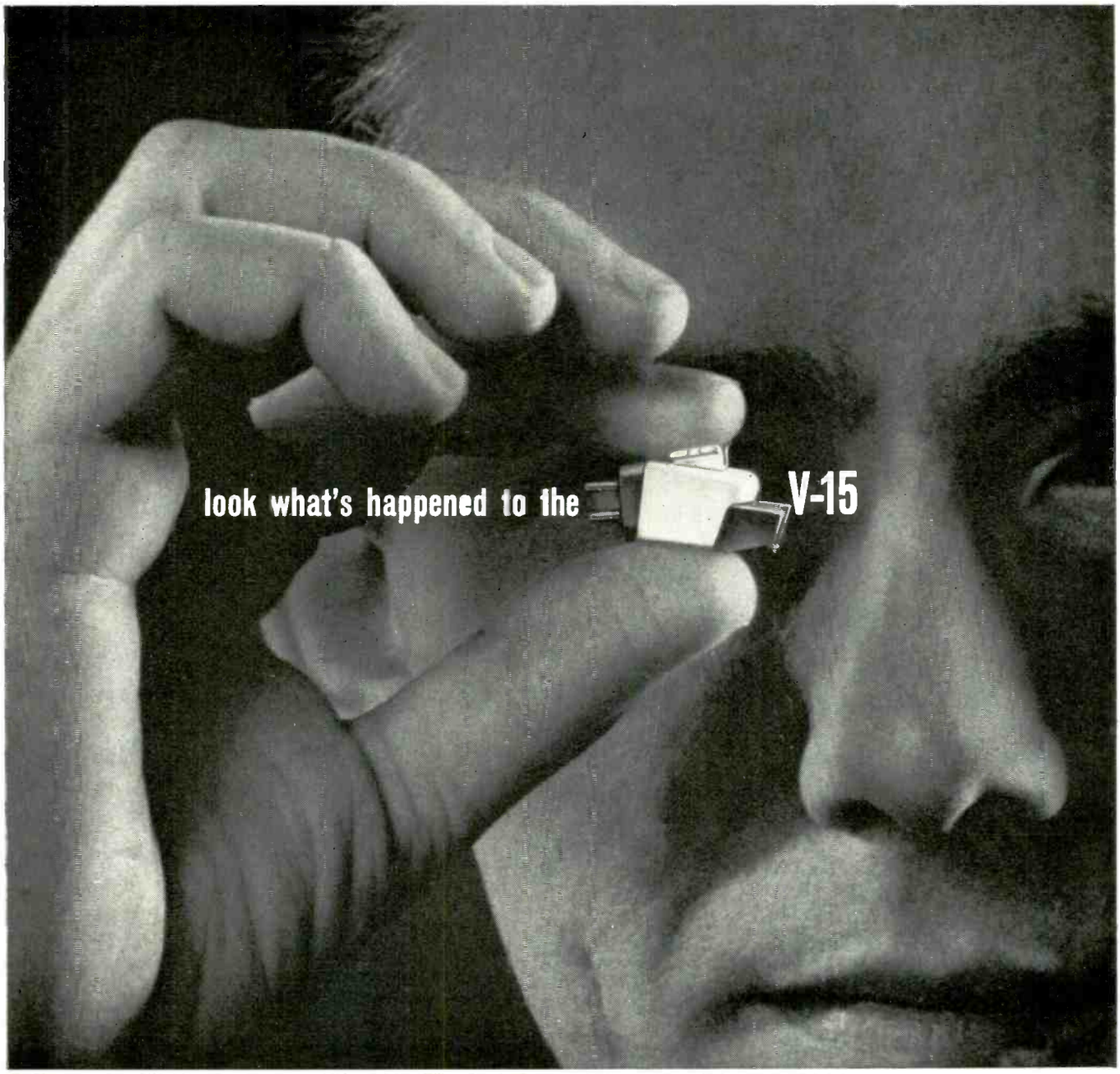
This year we are all in for a treat, two high fidelity shows instead of one this fall. The first one takes place in San Francisco this month. The dates of this show are September 10–13, and the place is the San Francisco Hilton.

In October we have the New York High Fidelity Music Show, and it takes place from October 1–4 at the New York Trade Show Building. Isn't this a good opportunity for out-of-towners to visit the World's Fair.

Also in October we have the Audio Engineering Society Convention which takes place from October 12 through 16 at the Barbizon-Plaza Hotel.

CORRECTIONS

In spite of the fact that the August Product Preview was the largest and most comprehensive to date, the number of errors seems to have been exceedingly small. Most of the errors were cross-reference omissions from the list of manufacturers, and only a few were mistakes in the product listings themselves. On page 65 we list the corrections we are aware of.



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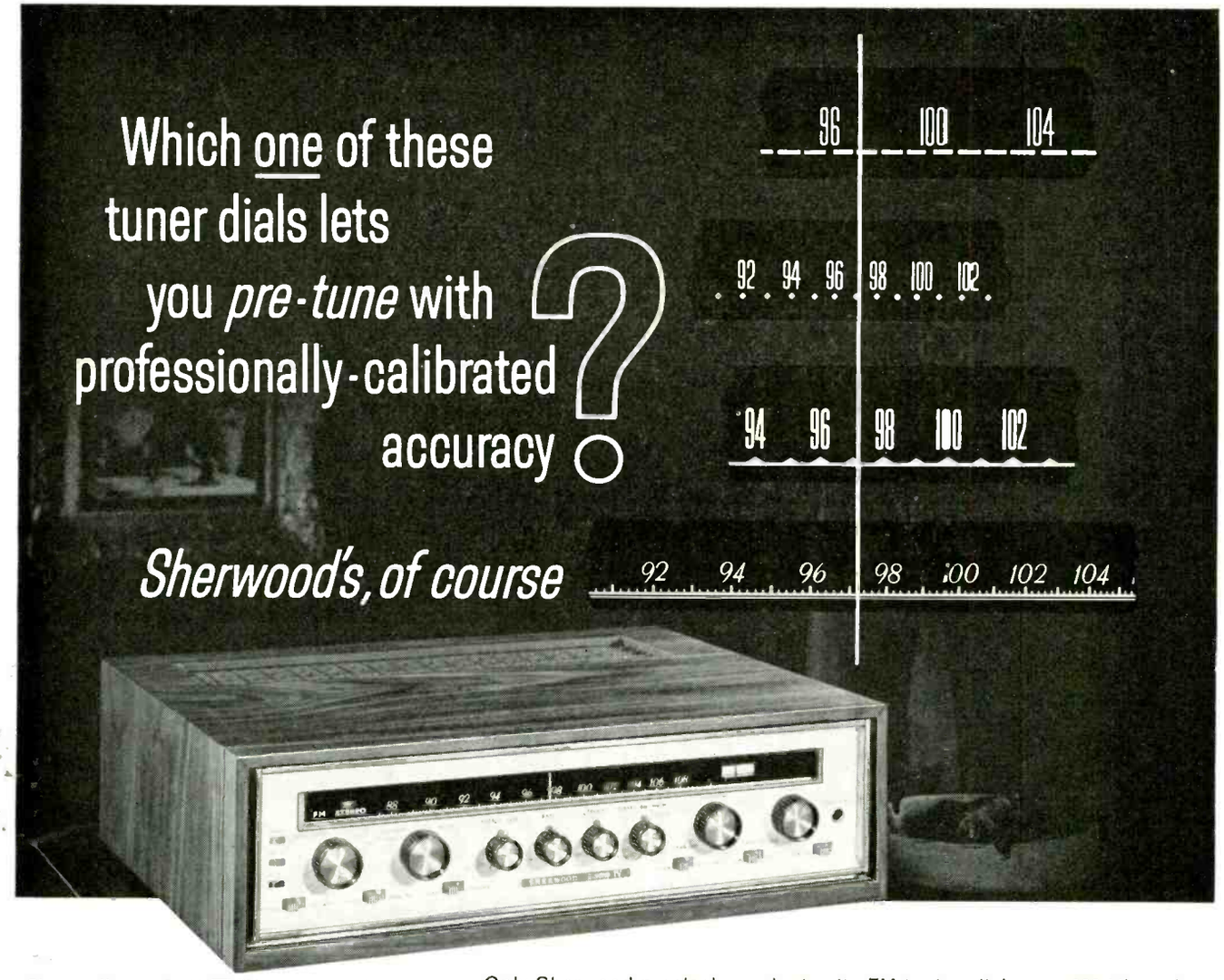
Circle 115 on Reader Service Card

Which one of these tuner dials lets you *pre-tune* with professionally-calibrated accuracy?

Sherwood's, of course



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Circle 116 on Reader Service Card

Automatic Speaker Connector

RONALD L. IVES

By suitable use of relay switching, powered from convenient local sources, any one of several audio devices can be automatically connected to the desired speaker or group of speakers, with correct phasing. If a second audio device is turned on while the first is operating, it will warm up, but will not actuate the speaker system until the first has been turned off.

Most of us, even as you and I, have collected several receivers and amplifiers, and use more than one of them fairly regularly. Most of us, also, have not yet gotten around to purchasing an independent speaker system for each "distortion generator." In consequence, change from one amplifier to another usually involves a wild scramble of disconnecting speakers from one, transferring connections to the other, then looking hurriedly for the misconnection, and finally worrying about the phasing.

All of this trouble can be eliminated by use of some sort of speaker switching device. If the speaker transfer system can be truly automatic in operation, so that turning on any given amplifier automatically connects the requisite speakers to it, in the desired phase, so much the better.

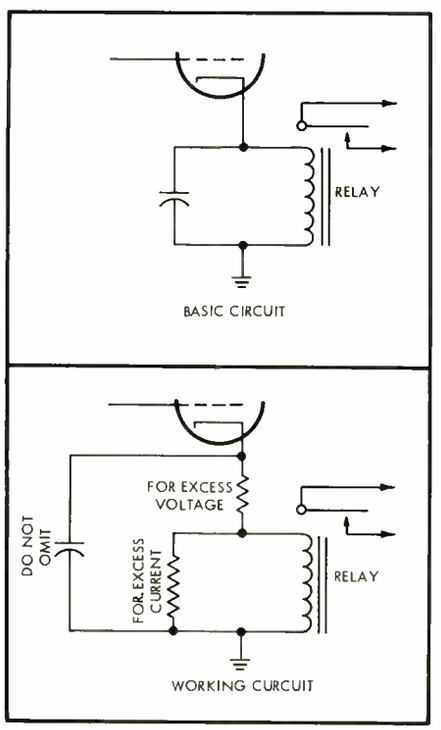

Fig. 1. Circuit of "free rider" cathode relay.

This can be done rather simply by use of relays, which, when properly powered and connected, are most dependable switching devices. In addition, relay switching can take place where it is needed, eliminating long cables of high-power leads to some central panel. The only problems facing most audio fans are where to get the power for the relays, and how to prevent trouble if someone turns on more than one amplifier at a time. Happily, these problems can be solved easily and inexpensively by a variety of methods.

Cathode Power

In most high power amplifiers, quite a few volts, at fairly high currents, are dissipated as heat in the cathode circuit of the final audio stage. Many push-pull Class AB_1 amplifiers have a cathode bias exceeding 15 volts, at currents of 80 or more milliamperes, so that the cathode resistance is of the order of 180 ohms. Power dissipation here is about 1.2 watts, so adequate power is available to operate any one of a number of 12-volt 1-watt d.c. relays. If current in the circuit is too much for the relay, a shunt resistance across it will carry the excess current, and a series resistor will drop any excess voltage. Generalized circuit for connecting a "free rider" relay in a power stage cathode circuit is shown in *Fig.* 1. *Do not* omit the shunt capacitor, or you will note some new waveforms in the output, for ordinary relays are inductive devices.

Bleeder Power

Quite obviously, a relay of proper current rating can be operated in series with the bleeder resistor of the power supply, as in *Fig.* 2A. This arrangement is not recommended, for opening of the relay coil, or disconnecting the lead to the low side, as this will leave the relay and the "high" lead at a very high potential indeed.

This hazard can be reduced greatly by shunting the relay with a resistor, assuming that adequate current is available, as in *Fig.* 2B. Now that fairly high voltage zener diodes are available, a bleeder connected relay can be made reasonably safe without requiring extra current by shunting it with a zener diode whose voltage rating is somewhat higher than that of the relay. A circuit for this is shown in *Fig.* 2C. Plate type relays, requiring from two to 15 milliamperes are ideal for this purpose. When bleeder currents are quite high, low or medium

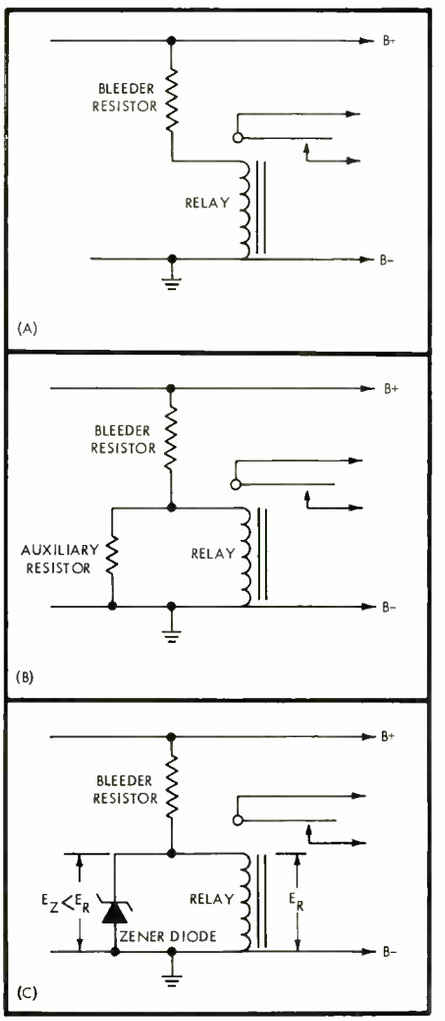

Fig. 2. Bleeder operation of relay.

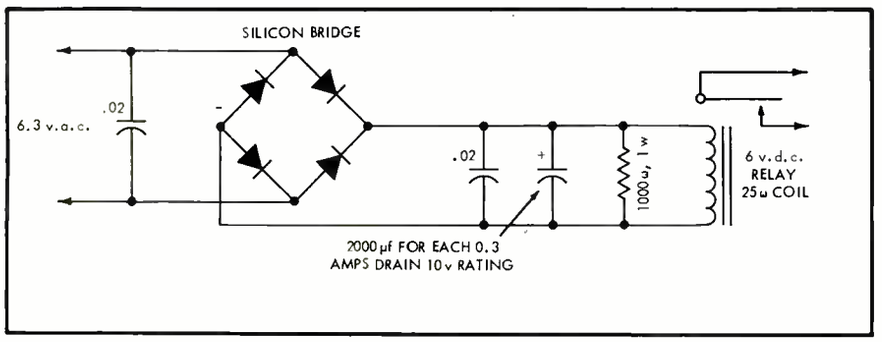

Fig. 3. Filament rectifier circuit.

power industrial d.c. relays (such as the Potter and Brumfield MR series) can be used in place of the more fragile and more costly "plate" relays.

Filament Power

For many switching operations, which require that a device be "ON" when the amplifier is on, and "OFF" when the same instrument is off, a relay shunted across the filament supply performs the requisite switching function admirably. Almost any 6- or 12-volt a.c. relay, of reasonably good make, with adequate contacts, will function well here. Rated voltage of the relay should be equal to the filament circuit to which it is connected.

When we are dealing only with high-level audio circuits, such as speaker lines, a.c. relays are entirely satisfactory, and connections by means of twisted pair (of adequate current capacity) are entirely workable. Connections consisting of a long single wire and ground should be avoided, particularly when one side of the speaker circuit is also a ground, to prevent the voltage drop in the ground return from being injected into the speaker circuit.

Where high level and low-level audio circuits are in close proximity, control lines carrying a.c. should be shielded, as well as being physically separated from low-level circuits insofar as possible, to prevent pickup at 60 cycles, various multiples thereof, and of miscellaneous line transients.

Rectified Filament Power

Where hum pickup from control lines or relay coils is, or might be, a problem, control by means of rectified filament power is preferable to use of raw a.c. With highly dependable silicon rectifiers available at relatively low prices, and high-capacitance compact electrolytics "over the counter" items, rectification and filtering of low voltage a.c., such as from the filament circuit of an ordinary amplifier, is no longer a serious problem. In addition, because of the efficiency of modern silicon diodes, d.c. voltage output of a rectifier-filter system can be made to equal the a.c. input voltage (rms) without the use of costly or bulky adjuncts.

A preferred circuit for rectifying filament voltage is shown in *Fig.* 3. Constants here shown are for 6.3 volts a.c. input. If a higher input voltage is used, simply increase the voltage ratings of the components by the same factor. A full-wave bridge rectifier is used here, not only because of its efficiency, but also because its output has a minimum ripple (120 cycles), and hence requires a much smaller capacitor than a simpler half-wave rectifier, all other things being the same. The 0.02 μf capacitors in this circuit are harsh filters, well worth the slight extra cost and labor of installing them.

Where available a.c. voltage is quite low, problems arise in getting enough voltage output for use with easily-available relays. One solution to this problem —rectification and filtering to produce a low-voltage at a relatively high current, which is then applied to an a.c. relay— has already been outline in AUDIO (Jan. 1964, pp. 36–37). A more elegant method, using a voltage—doubling rectifier and a standard relay, is shown in *Fig.* 4. This circuit is particularly useful when one side of each line is, and must remain, grounded.

Where the filament circuit is considerably above ground, the control circuit can be d.c. isolated from the filament circuit by use of a small isolation transformer, such as a Stancor type P-8191 (6.3 v. to 6.3 v., 1.2 amperes, 5000 volt rms insulation).

Separate Supply

If the control current needs are greater than can be safely or conveniently provided by either "free rider" circuits or by the filament circuit, a separate supply must be used. This should be transformer isolated from the a.c. line for safety reasons; but can have any convenient voltage, such as nominal 6, 12, or 24, to match available relays. The primary of the control supply transformer is commonly shunted across the primary of the power supply transformer, so that switching the main device also switches the control supply. For many applications, a 12-volt (nominal) control circuit supply is best, as it permits use of 12-volt relays plus series transistors for added control, with an ample margin of safety.

The circuit of a control supply, which is quite conventional, is shown in *Fig.* 5 Note its resemblance to *Fig.* 3, and to almost any standard bridge rectifier circuit. Because of its conventionality, this circuit can be adapted for other voltages and currents by logical and straightforward changes in constants.

Interlocks

When several controlling devices are used, some provision must be made to prevent interference of functions. If this is not done, two or more controlling devices may inadvertently be switched on at the same time, with unhappy or devastating results. Signal output of a speaker fed from two receivers simultaneously is seldom pleasing to the listener, and interconnection of two amplifiers, through the output circuit, may not be beneficial to either of them, particularly when certain forms of feedback are used.

To eliminate this annoyance or difficulty, a simple interlock, so designed that when the speaker is connected to one circuit, no other circuit can be connected to it, is desirable. Simplest form of this interlock, here shown for two signal sources, is shown in *Fig.* 6. With this circuit, when one relay is actuated, the other relay circuit is opened, so that if the second control line is energized, the second speaker line cannot be connected to the speaker until the first control line

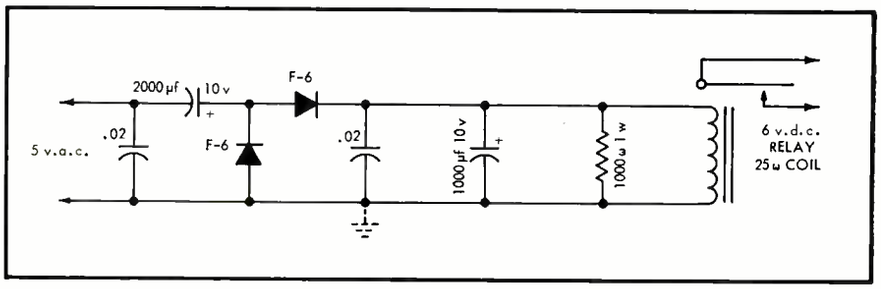

Fig. 4. Voltage-increasing rectifier circuit.

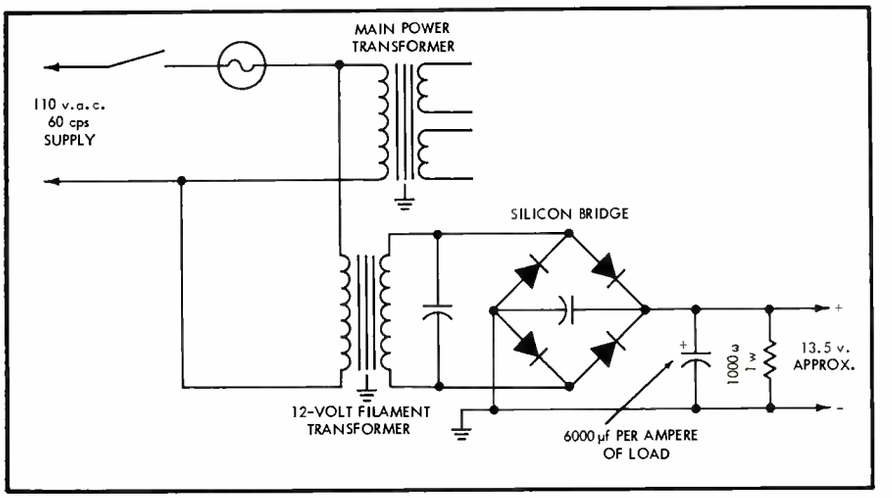

Fig. 5. Control supply circuit.

is de-energized. This same principle can be expanded to a system of N relays, contact requirements per relay then being those for the speaker connections plus N-1 SPST NC contacts per relay for interlock. Double pole contacts are shown here for the speaker connections to facilitate phasing. Where phasing is unimportant, and one side of each amplifier output is grounded, single pole contacts are adequate.

With this arrangement, either a.c. or d.c. relays may be used, the control circuits are electrically independent except for the interlock, and there is no compatibility requirement between them—all that is necessary is that they be capable of operating the relays connected to them.

Although this method of interlock is theoretically capable of almost infinite extension, its practical limit is three controls with double-pole switching, and four controls with single-pole. Larger systems run into rather extensive cabling and contact maintenance problems. Systems involving more than three or four controls are best interlocked by use of transistor-gated relays and diode matrices, a technique which has been detailed elsewhere.[1]

Safety Measures

Too many audio systems are wired according to the general principle that anything that works once goes, however some care in planning and constructing the control system will eliminate not only a lot of diddling to find out what quit this time, but will also keep the building inspector happy and your fire insurance valid.

All control supplies should be fused close to the source, so that a short circuit in the output will burn out the fuse, and not the rectifier or power transformer. Replacement fuses are very much cheaper than replacement rectifiers or transformers.

Control lines, even though they carry relatively small currents, should be made of good grade wire, adequately insulated, and physically strong enough to handle the mechanical stresses to which most cords are subject during their service life. Despite their convenience and low price, some of the dual "zip cords" now on the market should not be used, as they are apparently insulated with used chicle, and they tend to short out after a few months of use.

Wherever possible, control lines should be connected by use of distinctive plugs, unlike those used for any other connection in the installation, so that a wrong connection cannot be made. Use of female connectors for "hot" (source) leads, and of male connectors for cold (load) leads, is a recommended practice, even when voltages concerned are harmlessly low.

When interlocks are used, some means must be provided so that all amplifiers operate with a load. No-load operation of some amplifiers can result in oscillation, with resultant damage to the output transformer, and possibly to other components.

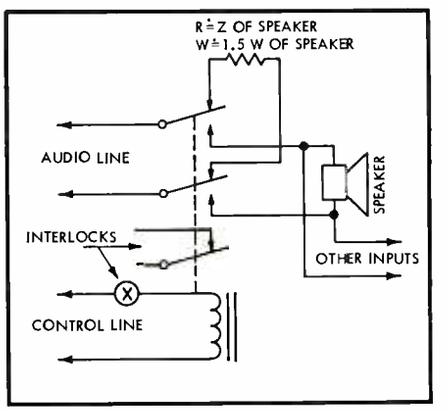

Fig. 7. Protective resistive loads.

This problem can be solved most simply by the use of suitable load resistors, as shown in *Fig.* 7. With this arrangement any speaker line that is not connected to a speaker is connected to an equivalent load resistor. In consequence, any amplifier that is turned on is automatically loaded.

Although careful labelling of all output plugs and cords may seem unnecessary, this practice saves a lot of errors and blunders during the life of the equipment.

The cost of an automatic audio switching system is relatively small, and maintenance needs are also small, if good components are used initially, and high grade workmanship is used throughout. Æ

[1] Ives, R. L., "Simplifying Control Interlocks," NRI *Journal, in press.*

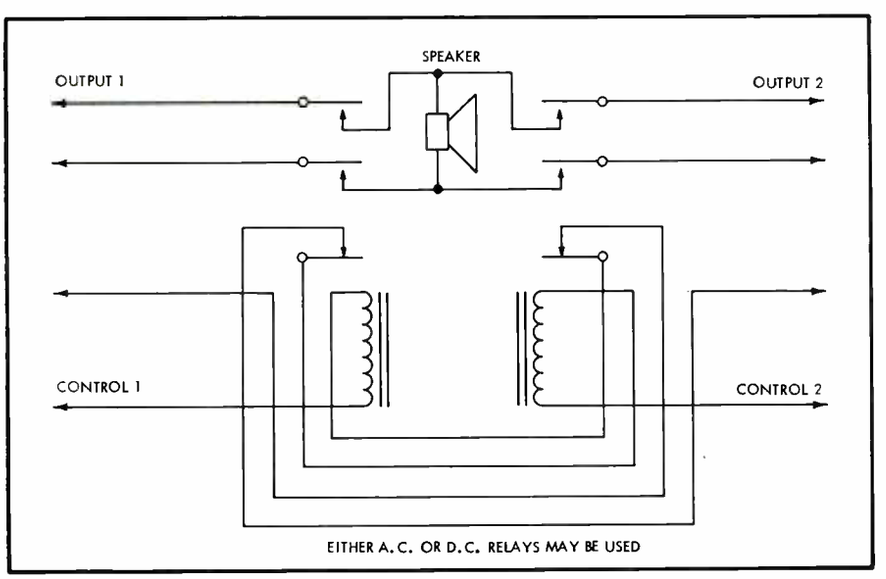

Fig. 6. Simple interlock circuit.

Transient Generators For Audio Testing

JOHN L. GRAUER*

Circuits are given for simple transient generators which can be inexpensively built with standard parts, to evaluate impulse response of audio equipment, using a sinusoidal tone-burst, a non-sinusoidal tone-burst, and step-function signals.

A PRINCIPAL CONCERN of designers has been the evaluation of steady-state frequency response of audio equipment. This has proven rather easy to do, as there is much test equipment available to verify results. One can readily sweep the circuit under test with a signal, and measure the magnitude deviation at the output. A continuous signal facilitates measurements with simple equipment, because the signal can be kept on long enough for the operator to obtain readings. The wave is normally a sine wave.

Another important test is under transient signal, to ascertain that the design will do justice to changing waveforms and impulses, which occur in all music. The square wave test is often used, on the assumption that equipment able to handle fast rising waves with a d.c. component will sound better.

The extreme difficulties with this notion have been brilliantly elucidated by Crowhurst, for both high-frequency and low-frequency cases. Part of these come from trying to evaluate transient performance with a continuous signal which tends to set up a steady-state condition in the equipment under test.

Briggs has shown that for speakers there seems to be no relationship between the bandwidth and the transient response, and has designed a simple test circuit for evaluating speaker transient response. As this method utilizes a d.c. step function signal, which is certainly a true impulse or transient, the results obtained would seem to bear a closer correlation to non-steady-state performance.

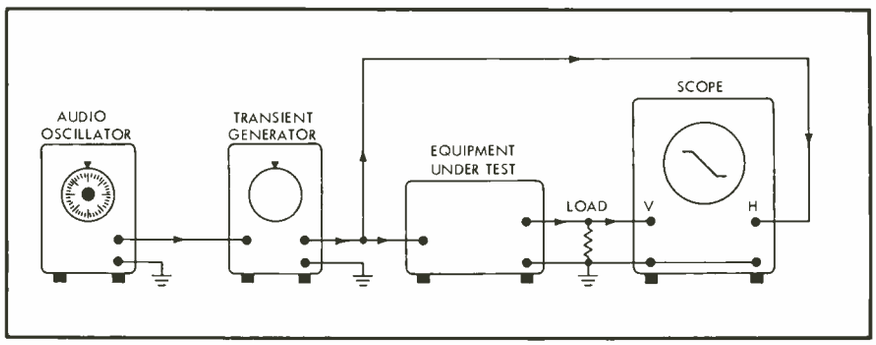

Fig. 2. Equipment setup for transient response tests by transfer characteristic.

The difficulty here is that the signal lasts only a fraction of a second, and expensive photographic equipment, along with very low sweep rates, seems necessary to compare results. In addition, no numbers can be readily assigned to the amount of deviation found, as, for example, a 5 per cent transient distortion. The scope, however, does display the deviation accurately, and with random repetition of a standard signal, and a little care, it is possible to get a good idea of the seriousness of the defect.

Very sophisticated delayed response curves have been done, but these require elaborate equipment, a certain amount of time to plot the results, and skill in interpretation.

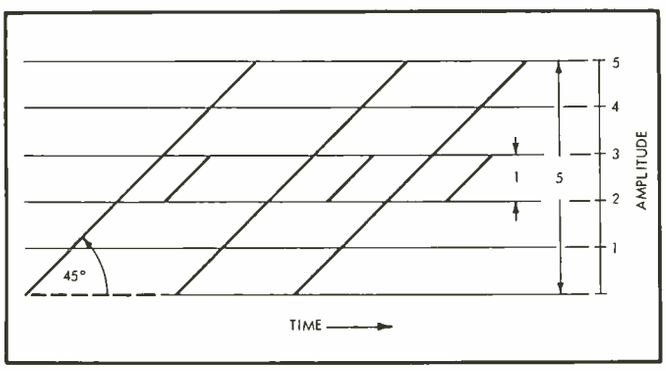

Fig. 1. Ideal transfer characteristic patterns using a switched sinusoidal waveform.

In feedback amplifiers peaks and resonances occur at very low frequencies, on the order of 1 or 2 cps, and can occur even when steady-state response evidence is swamped by output transformer rolloff. The seriousness of this, on program, has been pointed out by Crowhurst. Obtaining such resonance data is doubly difficult both because of swamping, and because of limited test equipment range: most oscillators do not go below 20 cps, and most voltmeters and a.c.-coupled display devices become increasingly inaccurate below 20 cps.

The problem, then, is twofold. First, what is a proper signal to expose such effects, and, second, how can a test be conducted so that expensive equipment is not needed to evaluate effects taking place in a short time. The test must assure that under typically musical conditions, where the material (signal) is changing continually and virtually at random, the very low frequency region will be non-resonant and well-damped.

The proper way to do this is to feed in a signal which will excite such a resonance, and evaluate the distortion produced. This must be accurately done at the moment—without extensive photographic means—so that the circuit can be conveniently changed and re-evaluated until the required performance is obtained.

Experiments revealed that transient distortion of this type can be observed by switching a steady wave on and off, or

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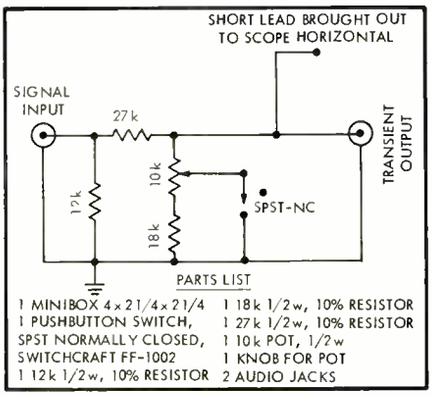

Fig. 3. A.C. transient generator.

on and partly off, and viewing the deviation produced as a transfer characteristic non-linearity on a d.c. scope.

The tests require a d.c. scope with identical amplifiers, and thus low phase difference between channels, such as the Heath IO-10 ($80), a sine generator (Knight audio generator), simple auxiliary devices described herein, and, of course, the equipment under test.

Evaluation by transfer characteristic works well because any very low frequency transient effects appear on the scope as a slow vertical modulation (bounce) of the trace, which dies out in a short period of time (about ½ second). In an ideal case, there is *no* vertical oscillatory motion, and the recovery time from a peak signal of any duration is zero.

The ideal pattern can be seen by feeding the input transient to both scope inputs (vertical and horizontal), where the trace should appear as a straight line (at any frequency), always 45-deg. from the horizontal plane, with the length in direct proportion to the signal amplitude. The pattern is shown in *Fig.* 1, for a sine wave of 5 to 1 change in amplitude.

As the signal amplitude is switched up and down, the trace jumps between the small pattern and the large pattern. Because the scope sweep generator is disabled for this test, the trace actually remains centered on the screen, without horizontal movement, as shown in *Fig.* 1. The line therefore sits still, and appears to lengthen and shorten instantly with switching.

The basic setup for taking transfer characteristic traces is shown in *Fig.* 2. The signal generated by an audio oscillator is fed through a transient generator, and the unit under test, which is terminated in its proper load. The vertical scope input feeds from the load, while the horizontal scope input feeds from the output of the transient generator. What is seen on the scope is a display of input versus output—a unique dynamic "dual trace"—which shows both steady-state and transient distortion components with accuracy and perspective. This occurs because amplifier deviations are present only in the vertical channel, while the horizontal channel always follows the input signal.

This gives the total picture of instantaneous difference in signals at every moment. The effect of reactive loading can also be seen. In addition, valid tests can be done with signals of other than sinusoidal shape.

The transient generator used in the setup of *Fig.* 2 is shown in *Fig.* 3, and consists of a resistive network and pushbutton switch, which turns the wave passing through on and "off," when the operator pushes the button. The waveform produced is shown in *Fig.* 4. The audio oscillator output control determines the larger amplitude level. The lower level can be adjusted from 0 (off) to about ⅔ of the larger amplitude, by setting the pot. A 4- or 5-to-1 ratio gives good readings, though this can be changed as required.

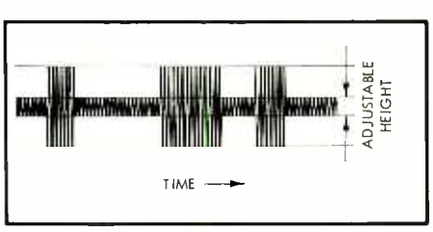

Fig. 4. Output wave of generator.

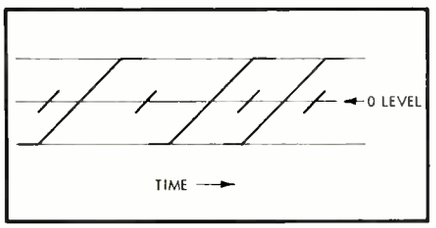

Fig. 5. Transient transfer characteristic pattern.

The design of the a.c. generator derives from a "straight" resistive voltage divider circuit, where the output signal is equal to E_{in} times $(R_1)/(R_1+R_2)$. E_{in} is the a.c. voltage applied to the high side of the divider (top of R_2), with the output voltage being taken from the junction point of R_2 and R_1. R_1 returns to ground. In this design, R_2 is 27k, while R_1 is split into a 10k pot and an 18k fixed resistor. A normally-closed switch—which should have no contact bounce, to give cleanest make and break—shorts out most or all of the bottom leg (R_1), which reduces the value of this resistor to anything from 10k through 0 ohms. Any E_{in} signal applied is then attenuated by a factor continuously variable from about $E_{in}/4$ through infinity. This gives complete control of the lower amplitude level.

When the switch is touched (opened), the attenuation is reduced by "unshorting" R_1, making the signal rise instantly to

$$E_{in} \times R_1/(R_1+R_2) = E_{in} \times \frac{10k+18k}{10k+18k+27k} = 0.5\ E_{in}.$$

When the switch is released (closed), the amplitude jumps back to the lower level.

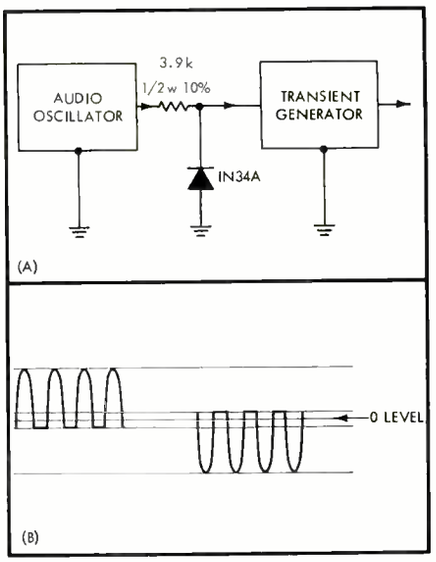

Fig. 6. (A) Asymmetrical generator; (B) waveform of asymmetrical generator.

An important feature in the design is the 12k resistor across the input, which serves to bleed a signal current to ground, and thereby stabilize the input voltage applied to the resistive network from the oscillator. Also, the switch used, most conveniently a pushbutton type, must have very low contact bounce, otherwise it will tend to cause an imperfect and confusing transfer characteristic pattern during the switching interval. An inexpensive switch, Switchcraft model FF-1002, serves admirably, having a contact bounce which is virtually undetectable. It consistently outperformed switches of other type and construction.

By using the switch to effectively short out part of the signal, rather than to, say, alternate between two signals of different level, a good clean switching pattern is assured, because of only two modes of operation (up and down). With an alternating design, a third mode would be present—during the time interval between the switching break and make. Even a very fast switch would tend to blemish the pattern purity in this in-

(*Continued on page 59*)

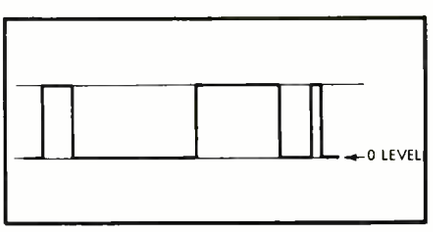

Fig. 7. Waveform of d.c. generator.

A Note on Curve Plotting

VIRGINIA RETTINGER*

The use of the time constant of a particular circuit as a means of expressing the shape of a curve is becoming more common. Here's how to use this technique.

THE LITERATURE OF ELECTRONICS and audio engineering often employs the concept of time constant (of a particular circuit) for describing the response curve of an amplifier. Some readers may not be familiar with this concept, or else, may not wish to take out the time in making a whole series of calculations (depending on the number of circuits involved in the description of the curve). It is the purpose of the following to clarify this concept of time constant and to provide a set of curves which quickly provide the required information.

As an example consider the following text, taken from the EIA Standard RS-288 "Magnetic Playback Characteristic at 7½ ips:"

2.2.1 IN GENERAL, a curve that falls with increase of frequency at the rate of 6 db per octave, but modified—

2.2.2. AT LOW FREQUENCIES, be a curve that falls with decrease in frequency in conformity with the admittance of a series combination of a capacitance and a resistance having a time constant of 3180 microseconds, and further modified—

2.2.3. AT HIGH FREQUENCIES, by a curve that rises with increase in frequency in conformity with the admittance of a parallel combination of a capacitance and a resistance having a time constant of 50 microseconds—

2.2.4 THE COMPOSITE CURVE is shown in Figure 6 of the N.A.B. Recording and Reproducing Standards Supplement #2 dated June 1953.

There is obviously no problem connected with the first part of the above text which calls for a curve that falls with increase of frequency at the rate of 6-db-per-octave. The second paragraph, however, may present a problem to some, particularly when no guiding curve is supplied with the text, as

(*Continued on page 63*)

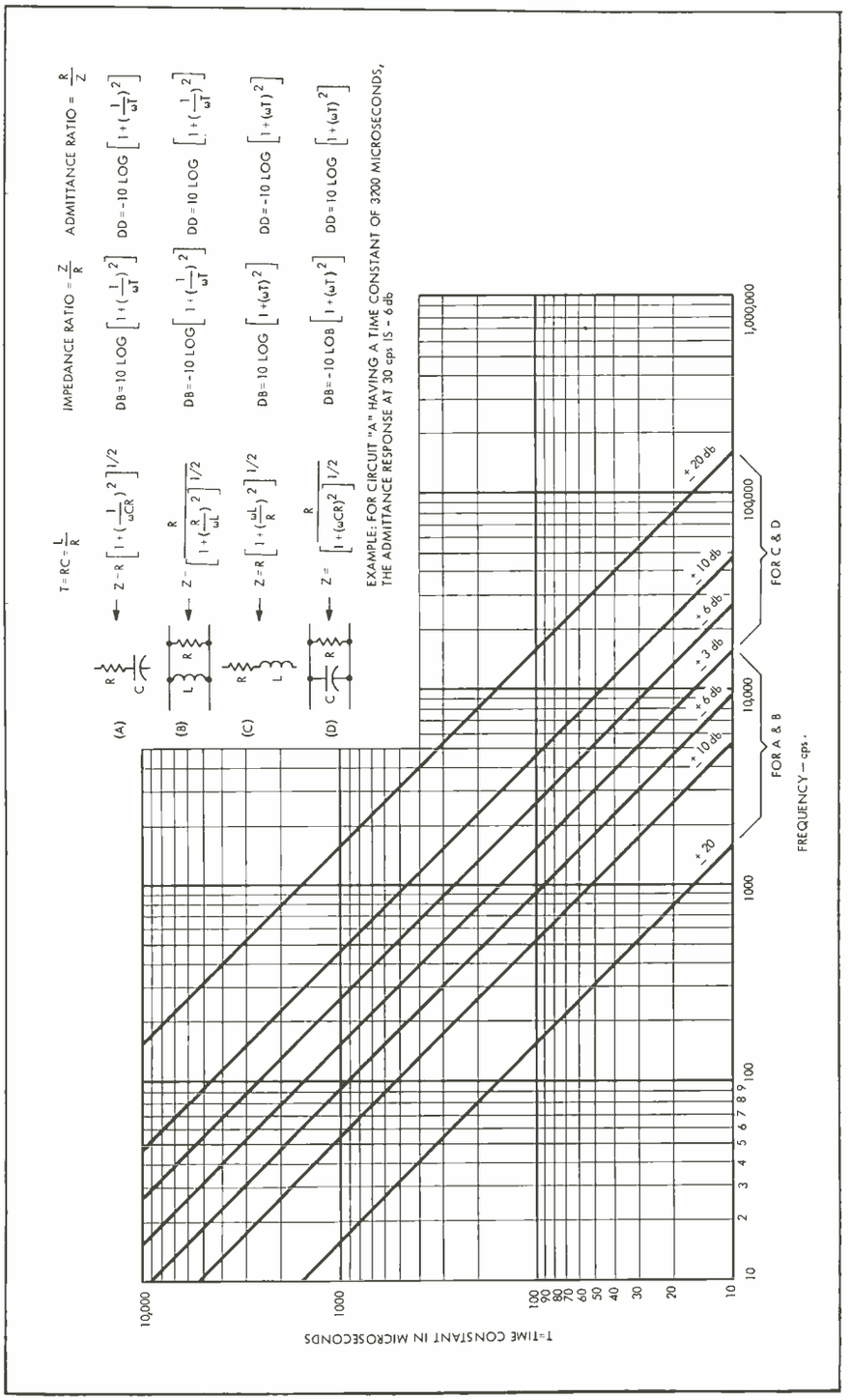

Fig. 1. Curve showing the time constant of various circuits at a particular frequency.

* *5007 Haskell Ave., Encino, California.*

PERFECTIONISM IS NOT INEXPENSIVE, EVER

Over two years ago, word leaked out (as it will) that Shure, one of the world's most respected manufacturers of high fidelity components, had embarked on an epochal project: the creation of a perfectionist's compact stereo system. A high fidelity system that conjoined optimum sound and minimal size.

A formidable and dedicated group of development and design engineers was given carte blanche.

Independent high fidelity authorities were flown in for repeated consultations. Their recommendations and comments provided a demanding framework for Shure engineers.

Prototypes were modified and improved . . . and improved again . . . and again.

The monies and skills appropriated to the project were sizable — by ANY standards. Perfectionism is not inexpensive, ever.

THE M100 SYSTEM

The result of this highly disciplined creativity is Shure's M100 Maximum Performance component high fidelity system. It is not just good, it is great.

It will re-create your favorite records with a sound quality that is remarkable in its naturalness and exciting in its impact. It is unlike anything previously available in compact systems—save perhaps a highly-inspired custom component rig costing two (or more) times as much. The M100 costs around $400 to $450 depending on cabinetry or case.

Because of the singular standards for sound and for size that were set for the M100, few components were judged to be satisfactory for inclusion in the unit. Consequently, the Shure design staff (that developed the unique Dynetic cartridge which made true high fidelity stereo a practical reality) designed many of their own components. In addition, quality is controlled by the famous Shure Master Quality Control Program.

The M100 embodies significant and unique engineering considerations, such as a solid-state pre-amplifier/amplifier developed and produced by Shure with more than ample power to drive its two total-range, ultra-compact multi speaker systems, also designed by Shure. And, it features the renowned Shure Bi-Radial Elliptical Stylus in the famed V-15 Stereo Dynetic 15° tracking cartridge. Naturally, it cannot scratch records. Dual's finest precision Model 1009 automatic turntable is standard.

The M100 can be used with AM, FM, Multiplex tuners, or be used as a public address system. Ideally suited for every home-listening requirement, the M100 is also recommended for use in schools, hospitals, and other institutions. It is Underwriters' Laboratories, Inc. listed.

Space is not sufficient here to list all the M100's pertinent specifications. They are for a system of this size, singular. We will be happy to send complete specifications to technically oriented music lovers.

LIMITED QUANTITIES

Because of the detailed craftsmanship, large amount of hand-labor, and rigid quality control and inspection techniques involved, the number of M100 systems manufactured will be few. They will be available only through a select group of the most experienced high fidelity consultants and dealers. We cannot promise immediate delivery. For perfectionism cannot be mass produced.

THE M100L PORTATIVE SYSTEM

In two instrument cases. Recommended for serious listening among music lovers on the go: armed forces members, boat owners, college students, school music directors, or anybody given to travel. Or summer cottage owners, of course.

THE M100W LIBRARY SYSTEM

Impressive solid walnut cabinetry designed to complement the decor of modest or magnificent homes and apartments.

SHURE M100

MAXIMUM PERFORMANCE COMPONENT MUSIC RE-CREATION SYSTEM

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois

Circle 118 on Reader Service Card

IITRI: R & D For The Tape Industry

ROBERT ANGUS

What's new in tape? AUDIO decided to find out by going to the pioneer research organization in this field.

ONE DAY IN 1939, a junior at Illinois Institute of Technology was faced with a problem: his cousin was studying singing, and needed a low-cost device which would enable him to hear himself as he practiced. There were disc recorders on the market—but the cost of a large number of discs would be high, and these recorders were both bulky and inconvenient for an amateur to operate. So Marvin Camras began experimenting with a device which could record sounds on piano wire by magnetizing portions of wire. Because the same length of wire could be used to record over and over again, the wire recorder would answer his cousin's prayers. By the time he graduated the following year, Camras had developed a machine which would record a wide variety of sounds for electronic playback. That wire recorder, which the student brought along to class to show his professors, was an early milestone of an organization which has become known as the back room of the magnetic recording industry—the laboratory in which research and development is done for IITRI's magnetic recorder licensees in the United States and around the world.

IITRI—The House of Research

IITRI, which in 1940 was known as Armour Research Foundation, had been founded four years earlier by IIT faculty members to provide coordinated research for industry. Upon his graduation, Camras was urged by his professors to join ARF and continue his research into magnetic recording. At the time, most activity in magnetic recording was taking place in Germany. The Magnetophon, manufactured by AEG, used a plastic tape and operated at 30 ips—but the German Ministry of Propaganda was taking all the units AEG could produce, and wrapping them tightly in a blanket of security. In 1941, Camras' experimental work on wire recorders was put to good use when the armed services asked Armour to manufacture recorders for military use. During the year, he developed a method of a.c. biasing in use on all high fidelity recorders today, and Armour applied for a patent on it. The patent is one of 400 held today by IITRI, the income from which provides the financing for further research into magnetic recording by Camras and an IITRI staff.

Other Camras-IITRI patents include

Fig. 1. The wire recorder shown here is one of hundreds made by Armour Research Foundation during World War II for the U. S. Armed Forces. At left is Marvin Camras, who developed and patented the machine in 1939. (1943)

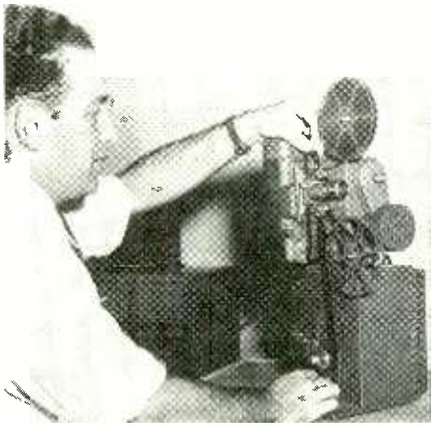

Fig. 2. Camras adjusts film in projector modified to pick up magnetic sound stripe. (1956)

one on manufacturing audio tape which covers most of the sound tape on the market today; one covering the use of high frequency bias, which produces high fidelity tape sound; the non-automatic straight-line feed system used by most manufacturers today on recorders; a head assembly which insures complete erasure of recorded tape, preventing the intermixture of new and old recording; the cross-field head, introduced last year, which yields high fidelity at slow tape speeds; and a compatible automatic tape cartridge playing system.

From its somewhat informal beginnings, IITRI has grown to include a staff of 1752 persons, nearly half of whom are professional personnel, working on projects totalling an estimated $25 million. IITRI owns a physical plant worth more than $25 million, not including a $10-million 20-story research tower due to open early next year. In addition to its research on magnetic recording, it has 15 departments covering a wide range of industrial and governmental research. The departments are Physics Research, Geophysics Research, Fluid Dynamics Research, Astro Sciences Center, Metals and Ceramics Research, Chemistry Research, Life Sciences, Electronics Research, Computer Sciences, Product Development Center, Mechanical Engineering, Solid Mechanics Research, Management Research, Extra-Hazardous Test Facilities and Research Services and Principal Equipment. Some of the

TO PROVE TO YOU...

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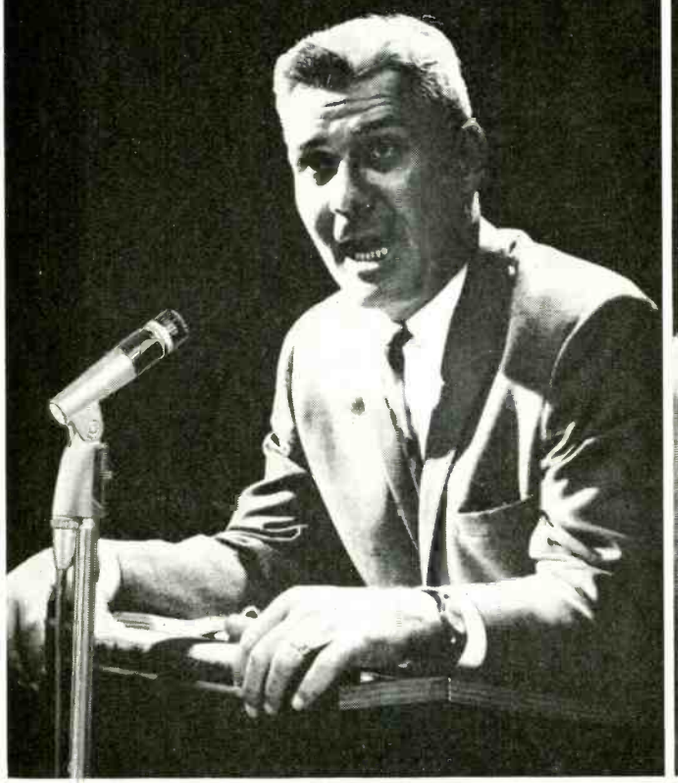

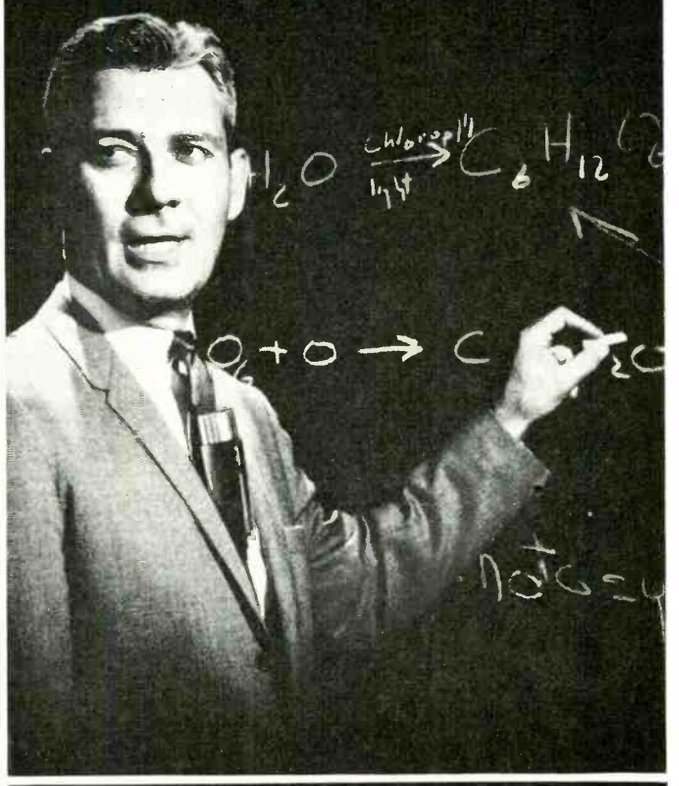

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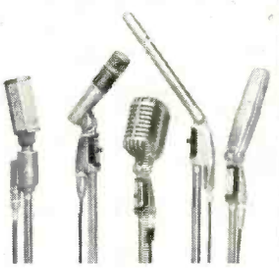
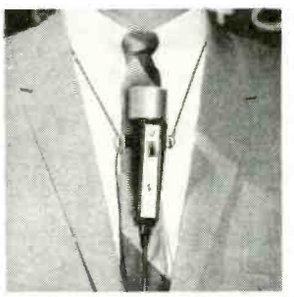
*Models 300, 315, 330, 333, 55SW, 55S, 545, 545S, 546, 556S, 576, 578, 578S. A Shure Lavalier for only $5.00 with each, when you send in your guarantee registration card. Offer expires December 31, 1964.





For lecturers, teachers, ministers, managers, public speaking requires the freedom and flexibility of a second microphone. The ability to move around while talking frees the speaker for writing on a blackboard or handling visuals, makes any speaker more interesting, more effective. Prove it to yourself for only $5.00 when you buy a Shure Microphone for fixed-location use.

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Mail to Shure Brothers, Inc. with your check or money order for $5.00. If sending cash please send by registered mail.

That's all there is to do. Your microphone will be sent to you post paid. Sorry, no C.O.D.s.

SHURE

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

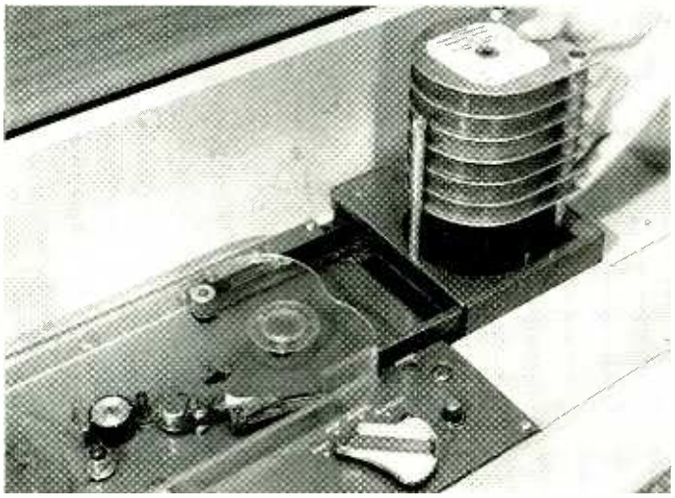


Fig. 3. Automatic tape cartridge changer uses cartridges the size of large pill box loaded with standard recording tape. Number of cartridges which may be stacked at once and changed automatically is almost unlimited.

research is done under contract, such as a $280,000 study of metal fatigue, paid for by 20 industrial sponsors; and space exploration research supported by the National Aeronautics and Space Administration. In other cases, royalties from patents which develop as a result of these and other research projects help to pay for additional research. IITRI, although it is a non-profit-making organization, certainly pays its own way.

A Chief Resident

Camras today is a youthful (though harried) engineer of 48. His interests, when AUDIO talked to him recently in his office at IITRI, include a good quality home videotape recorder ("We don't have it yet,"), a revolutionary development in tape as an instrument for business dictation ("We're close to that,"), a cartridge player system which is compatible with reel-to-reel recorders and can produce top fidelity ("We've had it for several years") and a way of getting high-fidelity reproduction at slow tape speeds ("We've licked a number of electronic problems. Now we're faced with mechanical ones"). He divides his time between work and membership in 11 professional associations and societies in all of which he takes an active part. Somehow, he still has time for his wife and three children who reside in suburban Glencoe, Ill.

The history of recording on tape in America is the story of Marvin Camras' research since 1940. By 1942, for example, he had designed a wire recorder to fit Navy specifications. In 1946, while Ampex was studying a captured German Magnetophon to learn the secrets of manufacturing one and J. Herbert Orr was trying German formulas for iron oxide and a binder, Camras was experimenting with sound-strip film. The following year, scientists at Minnesota Mining developed their own iron oxide and magnetic tape, only to find that the process they'd developed was already covered by a Camras patent. In 1949, as the first monophonic tape recorders suddenly won favor with the public, Camras held demonstrations in Chicago of stereo sound on tape. In 1954, he received the John Scott award for scientific achievement—the same honor bestowed upon such notables as Thomas Edison, Orville Wright and Madame Curie. The 138-year-old award, consisting of $1000 in cash, a copper medal and a scroll was presented to him for his discoveries and subsequent improvements in magnetic recording that helped skyrocket the industry into one doing an annual business well in excess of $160 million. He received the Illinois Tech alumni distinguished service award in 1948 and the *U. S. Camera* award for contributions to motion picture photography in 1949.

Some steps are long . . .

Not infrequently, it's a long step from Camras' laboratory to the living room. An excellent example is the cross-field head, which Armour first outlined to its licensees in a bulletin issued in 1952. Notes IITRI vice president Dr. James Brophy, "Although the design has been available to any licensee at any time since then, it wasn't until last year that a recorder actually included a cross-field head on a model in the U. S. market." The cross-field head is designed to record high frequencies at slow tape speeds—obtaining at speeds of 1⅞ ips and 3¾ ips frequency response which used to be obtainable only at 7½ or 15 ips. It does this by reshaping the magnetic field of the recording head to make a sharper recording pattern. In the cross-field design used by Roberts Electronics, for example, a coil is located on the underside (uncoated side) of the tape, opposite the record/playback head. In the alternative design, outlined in the 1952 bulletin and due to be introduced later this year by Concord Electronics, the extra coil wraps around the record/playback head and produces a magnetic field from the same side of the tape as the recorded signal. By creating a sharper field for recording, Camras explains, it's possible to get more wavelengths onto a given length of tape. Unfortunately, he admits, so far little has been done to improve tape transports to reduce wow and flutter. The result is a desirable frequency response which he calls "somewhat meaningless, because distortion from mechanical causes becomes so much more evident."

Dr. Brophy feels that with the tapes available in 1952, results with the cross-field head probably wouldn't have been very exciting. The low-noise tapes introduced for home use this year, however, have interested IITRI's tape recorder experts, very much—partly because they improve the signal-to-noise ratio, which becomes more of a problem at 1⅞ ips with the cross-field head. "You couldn't hear well enough before to care," one tape expert noted upon hearing the cross-field head. "Now things like signal-to-noise and wow and flutter become that much more important."

The cross-field head is one step in IITRI's long-range goal to reduce the "standard" speed of tape from 7½ ips

(*Continued on page 50*)

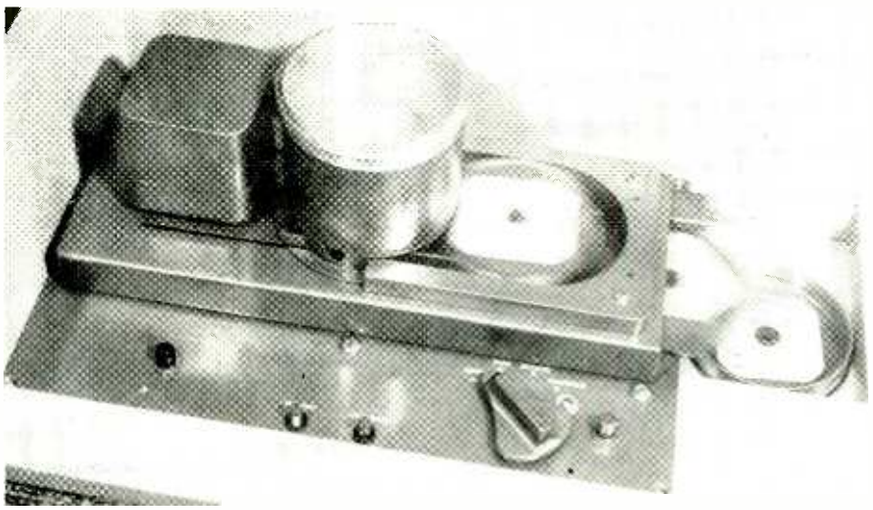
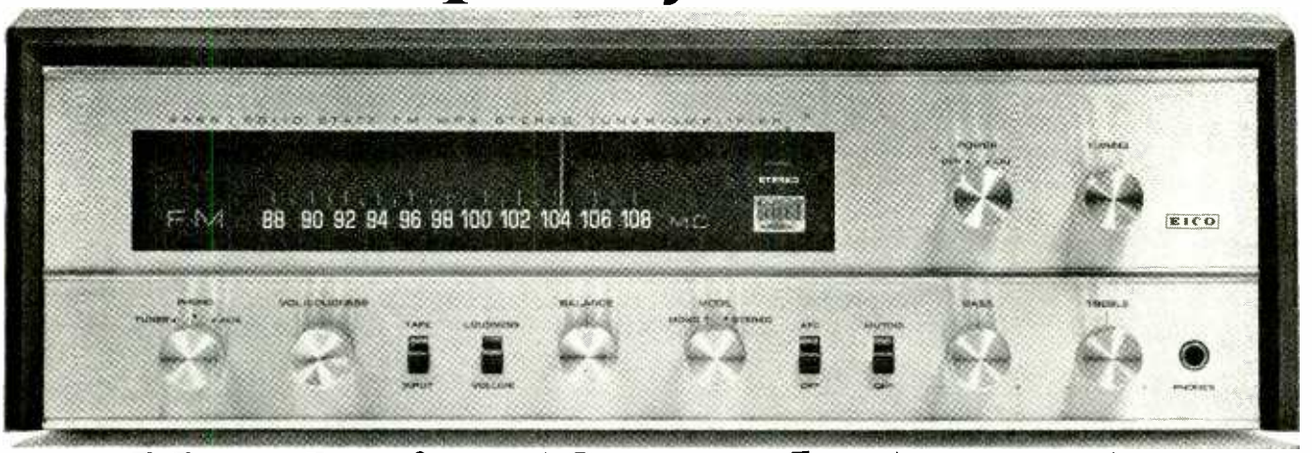


Fig. 4. IITRI automatic tape cartridge changer goes from one tape to the next with a minimum of interruption.

No other solid state stereo tuner/amplifier kit has EICO's $500-$600 quality...



and looks it. (for only $229.95)

Introducing the new 3566 all transistor F.M. MPX Stereo Tuner/Amplifier. Designed throughout to the quality level of the costliest Tuner/Amplifiers on the market.

SUPERIOR TRANSISTOR SOUND: Perfect deep bass fidelity, the clarity and detail of exactly reproduced transients... the sweet, airy quality achieved with extremely low distortion and extended frequency response. Plus plentiful reserve power for orchestral crescendos (even with inefficient speaker systems)—all against a velvet quiet background: This is the new **transistor sound** that is taking over in high fidelity... This is the sound of the superior new EICO 3566.

UNSURPASSED FM STEREO TUNER PERFORMANCE: Entirely new FM "Front End" and 4-Stage IF Strip with wideband ratio detector, developed only after the practical requirements of optimum FM Stereo performance were established by experience with earlier transistor designs in the field ... Achieves **Minimum Bandwidth Variation with signal level** for consistently high quality reception regardless of signal strength.... **Handles even abnormally strong signals without overloading** (a strong local signal won't "blanket" the dial)... **Unsurpassed usable sensitivity** with only slightly more signal required for full 40db quieting. **Time-switching** transistor multiplex circuitry, incorporating separation and balance adjusts, achieves outstanding 38db channel separation... completely effective filtering of all types of interference. Noiseless, purely electronic **Automatic Switching** between FM Stereo and FM Mono (controlled by the pilot frequency in stereo broadcast signal), with defeat. **Stereo Indicator Light** gives instantly visible indication of stereo broadcasts... **D'Arsonval tuning meter** gives exact center-of-channel tuning indication... **Adjustable-threshold interstation noise muting** gives you silence between stations while tuning, and infallible stereo program indication. Convenient Muting-Off Switch for weak station reception... **Exactly right AFC pull-in range** permits you to tune in stereo stations accurately with ease. Convenient AFC-Off switch for tuning in weak stations.

UNSURPASSED STEREO AMPLIFIER/PREAMPLIFIER PERFORMANCE: Entirely new amplifier/preamplifier circuitry, designed with the highest performance objectives. **Phenomenally low noise, low distortion RIAA phono preamplifiers** with maximum overload resistance. **Low distortion, variable inflection feedback tone controls** permit boost or cut at the extremes of the range without affecting mid-range response or the volume level. Isolated from power amplifier by buffer stages to eliminate loading distortion. **Unique, very low distortion drive of power amplifier output stages,** plus 36db of overall feedback to reduce distortion to an inaudible level. **No output transformers**—giving unrestricted bass response and eliminating transient distortions normally occurring due to output transformer characteristics.

SIMPLIFIED KIT ASSEMBLY: You wire only non-critical audio and power supply circuits, mostly on military-style terminal boards for easy checkout... **FM "Front End," 4-stage FM IF strip, and entire multiplex circuit pre-wired and pre-aligned... Transistor Sockets** eliminate risk of transistor heat damage... **This kit can be recommended to beginners!**

CONTROLS: Input Selector, Mode (incorporates FM stereo defeat), Volume, Balance, Bass, Treble, Loudness Compensation, Muting-off, AFC-off, Power on-off. INPUTS: Mag. Phono, tape, auxiliary, 300 Ω antenna. OUTPUTS: left and right speakers, tape, headphones. INDICATORS: Illuminated tuning dial, tuning meter, stereo program indicator light. FUSES: Line, Left Speaker, Right Speaker, SIZE (HWD): 5 x 16½ x 13¼ inches.

AMPLIFIER/PREAMPLIFIER SPECIFICATIONS: POWER: 66 watts total IHF music power output. IM DISTORTION: 2% at 30 wpc (watts per channel); 1% at 25 wpc; 0.3% at normal listening level. IHF POWER BANDWIDTH: 20-20,000 at 25 wpc, 0.5% harmonic distortion. HARMONIC DISTORTION: 0.16% at normal listening level. FREQUENCY RESPONSE: ± 1db 10-60,000 cps. HUM & NOISE: 70db below 10mV on mag. phono; 70db below rated power on other inputs. SENSITIVITY: 3mV on mag. phono, 180mV on other inputs. SPEAKER CONNECTIONS: 8-16 ohms.

FM MPX STEREO TUNER SPECIFICATIONS: SENSITIVITY: 2 microvolts for 30db quieting (IHF Standard), 2.7 microvolts for 40db quieting. IHF HARMONIC DISTORTION: 0.5%. CHANNEL SEPARATION: 38db. FREQUENCY RESPONSE: ± 1db 20-15,000 cps. IHF SIGNAL-TO-NOISE RATIO: 60db. IHF CAPTURE RATIO: 4.5db. IMAGE REJECTION: 50db. IF & SPURIOUS REJECTION: 80db. SCA REJECTION: 40db. 38 KC SUPRESSION: 55 db. 19 KC SUPRESSION: 45db.

EICO 3566 also available factory wired (includes oiled walnut cabinet) $349.95... optional oiled walnut cabinet for kit $9.95.

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3M COMPANY

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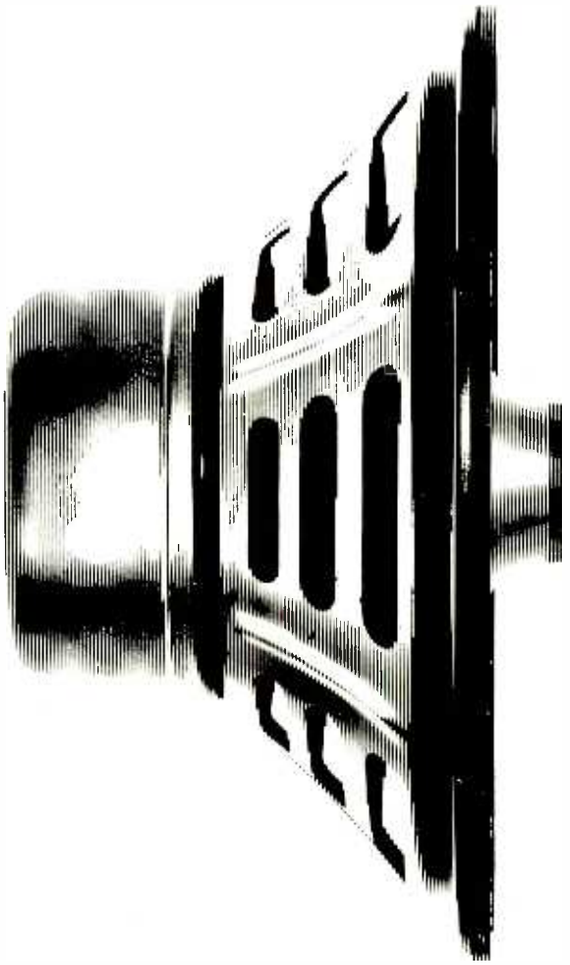
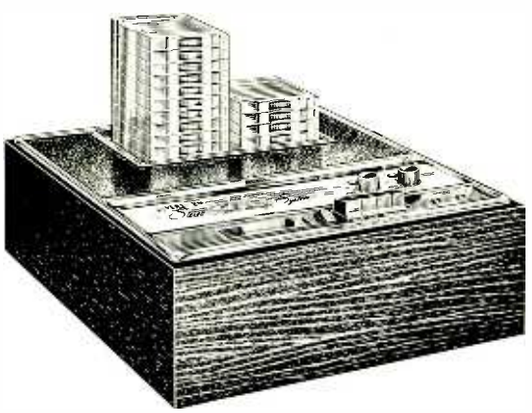




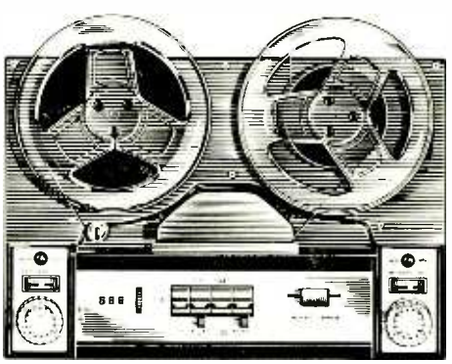
REVERE-WOLLENSAK M-20 AUTOMATIC STEREO TAPE DECK The newest idea in music now for custom installation! This amazing machine threads, plays, rewinds, changes tapes automatically. Up to 15 hours of uninterrupted music just by touching a button. Dual record/playback preamplifiers. Record in stereo or mono from any sound source, or choose from a wide assortment of pre-recorded tapes. Keyboard controls . . . high speed search lever . . . automatic and delayed shut-off . . . unsurpassed sound-on tape reproduction. *Also available in playback-only deck version, Model M-30.* SIZE: 14½" x 14¼" x 7". WEIGHT: 32 pounds.

WOLLENSAK 1981 "SOUND ROOM" STEREO TAPE DECK Designed for the serious tape recordist, incorporating two new module-type recording and playback amplifiers which provide 22 watts output. Superb stereo or mono recordings can be made from any sound source. Vertical or horizontal operation . . . 2 VU recording meters . . . convenient tab controls perform all playback and record functions . . . sound with sound . . . dual speed . . . automatic tape lifters . . . patented balanced tone control . . . patented head demagnetizer . . . complete professional stereophonic sound advantages. SIZE: 21¼" x 13¾" x 9 5/16". WEIGHT: 42 pounds.

WAIT TILL YOU INSTALL A REVERE-WOLLENSAK TAPE DECK!

You're in for a musical revelation. In fact, you're in for several pleasant surprises when you see and hear the four different kinds of Revere-Wollensak tape decks. Want to make your sound system the most convenient custom installation in the world? Install one of the Revere-Wollensak AUTOMATIC Tape Decks that change tapes even *more* conveniently than an automatic record changer changes records. Want to make your sound system the most professional and reliable custom installation? Then use any of the three Wollensak reel-to-reel decks. You can't go wrong. Take your pick. At your nearest dealer. Reel-to-reel or automatic . . . **WHAT YOU WANT IS A REVERE-WOLLENSAK!**

WOLLENSAK 1780 STEREO TAPE DECK For the sound perfectionist who wants to incorporate top quality Wollensak stereo recording and playback facilities in an existing sound system. Can be installed either vertically or horizontally. Dual matched record/playback preamplifiers . . . automatic head demagnetizer . . . sound with sound . . . instant pause control . . . cadmium steel enclosure with chrome trim . . . easy-to-operate tab controls . . . volume control for each channel . . . automatic shutoff . . . automatic tape lifters . . . many other outstanding stereo sound-on-tape features. SIZE: 13¾" x 14" x 5½". WEIGHT: 15 pounds.



WOLLENSAK 1281 STEREO TAPE DECK Now you can have the many advantages of a fine Wollensak amplified tape deck at a new *low* price! The "1281" is a beautifully styled unit that gives you true professional sound control: 4 track stereo and mono record and playback . . . horizontal and vertical operation . . . 2 VU meters . . . 7½ and 3¾ tape speeds . . . automatic cut-off . . . convenient interlocking tab controls . . . instant pause control . . . patented self-adjusting braking system . . . independent volume and tone controls on each channel . . . many, many more quality "custom" features. SIZE: 10¼" x 15⅝" x 5¾". WEIGHT: 20 pounds.

Circle 120 on Reader Service Card

HERMAN BURSTEIN

(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)
Herman Burstein
280 Twin Lake E., Wantagh, N. Y.

Tape Quality

The following is not a queston but a commentary by one reader which may echo the thoughts of other tape enthusiasts:

"I am primarily interested in classical tapes, and feel that a well produced tape cannot be excelled by any other source. However, there are many deficiencies in the duplication and production of such tapes which should be corrected. Of my 50-odd tapes, only about 10 can be played at concert hall volume without considerable background hiss. I believe that this is one reason why dealers seldom demonstrate their equipment with tapes. It is lamentable that such an otherwise superb source should be plagued by this annoying defect. There are now a number of fine tape machines on the market. What high fidelity needs is new, superior techniques for the production of tapes."

To this and other readers it may be encouraging to note that there are new low noise tapes coming into use which may help to improve the signal-to-noise ratio. Also, the new tape recorders used by professionals are an order of magnitude better than previous machines. What remains, is to find a better way of duplicating tape.

Instrument Tape for Audio?

Q. Is instrumentation tape as good for audio purposes as a first-quality audio tape with respect to frequency response? Also, how are the extended length tapes?

A. I cannot give you a definite answer on the use of instrumentation tape for audio purposes. A leading tape manufacturer has indicated to me that you may be taking some chance in using such tape. Tape is made optimum for each purpose, such as audio, computation, telemetry, and so on. A tape specifically for instrumentation, where it has to deal only with pulses, might have excessive treble response and inadequate bass response. This isn't certain, but quite possible. Also, it might have physical properties—such as immunity to squeal—that are not as appropriate for home tape recorders as for instrumentation devices.

I don't know whether your second question pertains only to frequency response or to all characteristics of extended length tapes? Frequency response will be about on a par with conventional tape. The main disadvantage of such tapes appears to be increased print-through because of their thinness and hence reduction of the barrier between oxide layers. However, if you are careful to record at moderate levels, you may not notice the difference in print-through.

Recording from TV

Q. I have a new tape recorder and would like to record from TV without using a microphone. Please let me know how to do this.

A. You can record from TV in three ways: (1) The simplest is to connect a cable to the two leads to the TV speaker; (2) you can connect a cable to the "hot" and ground leads of the TV volume control. This has the advantage of providing a signal with better frequency response and lower distortion than procedure 1, and of keeping the signal level fed into the tape recorder independent of the TV volume control setting. However, if the cable to the input of the tape recorder is more than about two or three feet long, there may be appreciable treble loss in the recorded signal; (3) you can try to find room on the TV chassis to install a cathode follower. Connect the input of the cathode follower to the TV volume control, and feed the output of the cathode follower to the tape recorder. Then you can use a long cable between the TV and tape recorder.

Copy Hiss

Q. My question involves copying tapes, using two Tandberg 64's. The problem seems to be that I get too much tape hiss on the tape copy. although the quality of the copy is otherwise excellent. I have tried several brands of tape, with more or less the same results. I also have tried a bulk eraser, but with no audible improvement. I have tried various combinations of the gain control settings of the two Tandbergs, again without effect on the hiss. I have tried recording at augmented levels (higher than indicated appropriate by the magic eye), but there is still more hiss on the copied tape than on the original one.

A. Each time you copy a tape, the tape hiss level rises about 3 db. This factor, inherent in the copying process and having nothing to do with your particular machine, accounts at least in part for the hiss you complain of. The only suggestion I can make, in line with your own thinking, is to record at the highest practicable level, thus maximizing the ratio between the audio signal and the hiss of the newly recorded tape. Bear in mind that commercial tapes usually have a higher hiss level than home-recorded tapes (because the former have gone through several generations of copying), so that in copying the former you are augmenting an already high hiss level.

Demagnetizing Tape Heads—A Yardstick

Q. There has been considerable discussion on the importance of demagnetizing the tape heads and guides. In general, this process is recommended after every 8 to 10 hours of use. Little has been written, however, on the many factors that contribute to building up the magnetization of the heads and guides. These factors, it has been asserted, may require demagnetization much more frequently than every 8 to 10 hours. For instance, the editing and indexing of reels of tape requires the frequent use of fast forward and rewind. The static electricity produced by the tape as it passes swiftly in close proximity to the heads will in many cases produce a sufficient field to magnetize the heads. Switching the tape machine on with the record selector in the on position can cause a momentary power surge to the record head, magnetizing it. Frequent switching between record and playback may have a similar effect, as (possibly) will frequent switching between quarter-track and half-track operation. When we take into consideration that the demagnetization process for a professional tape recorder, if properly carried out, involves demagnetization of each of the 3, 4, or 5 separate heads, each of the 3, 4, or 5 tape guides and lifting devices, the metal stabilizer roller and tension arm, and other parts, it can readily be understood that this becomes a rather arduous task if performed often. Therefore what the serious tape enthusiast requires is a meaningful yardstick by which to judge his particular need for demagnetization. This may be governed by how frequently he engages in those practices which result in magnetization. Would you kindly list and discuss the many factors that would be generally applicable to the professional and semi-professional recorder with respect to magnetization and demagnetization.

A. It seems that your letter provides me with more information than I can offer in return. About all I can say is that on the basis of experience, a number of authoritative persons have concluded that the tape heads and metal guides and other metal parts contacted by the tape should be demagnetized at least after every 8 hours or so of machine use. Some persons demagnetize oftener, for example after every 4 hours. If the heads have been exposed to a sudden surge—for example if someone has knocked over a microphone—they will demagnetize immediately or as soon as possible. It should be noted that some tape machines provide for self-demagnetization of the heads. That is, current flowing through the heads is allowed to die away slowly. Even so, it does no harm to demagnetize the heads regularly as an extra precaution. And the tape guides still require demagnetization.

High-End Loss

Q. I have noticed a drop in the high-end response of my tape recorder. Would substitution of metal film 1 per cent, 1-watt resistors and silver mica capacitors in the equalization circuit help? Or is the trouble a design error?

A. The equalization problem is probably not a design error but may be due to change in value of the resistors and capacitors in the equalization circuit. It will do no harm to replace the capacitors and resistors involved. As a side benefit, you may get a reduction in noise as the result of using metal film resistors. Furthermore, keep in mind that the loss at the high end may be due to excessive bias current, to a worn playback head, or to poor tape-to-head contact (because of dirt, oxide, and such on the heads). **AE**

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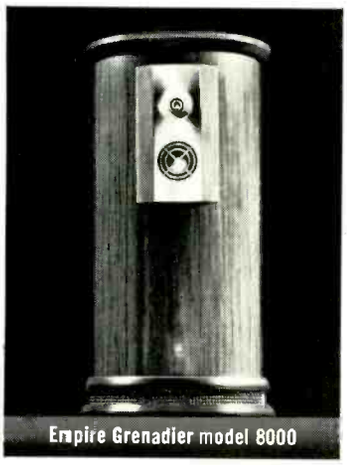

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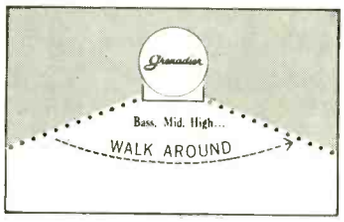
Started a new era in speaker systems. Measures 29" high with a 15¼" diameter. Its features are virtually the same as the 9000 plus the exclusive Empire Dynamic Bass Reflex . . . high Q reflex tuned columns for in-phase low frequency reinforcement. The scientifically accurate gradients and vented ports provide unbelievably enriched base response.



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A Basic Course in Commercial Sound

NORMAN H. CROWHURST

Chapter VI

Microphones and speakers are both important to a successful commercial sound system, although in somewhat different ways. In one respect the microphone is the more important: If it picks up too much background noise or reverberation, introduces hum, or distorts the sound picked up in any way, it is difficult if not impossible to eradicate this elsewhere in the system. Let's consider the various properties of microphones and see how important they are.

Frequency Response

The frequency response of a microphone must be smooth. Lack of smoothness affects naturalness of sound; it affects acoustic feedback problems and associated effects to a greater extent than similar deviations in individual speakers. It may also cause undue distortion in the amplifier, and it may make noise (both electrical and acoustical) more difficult to overcome.

The peakiness of a speaker's response is usually associated with some directivity effect: a peak on axis is somewhat compensated by less energy off axis at that particular frequency, so the total sound field averages out a bit. A microphone cannot do this. The sound source and microphone are in a fixed relationship, such that if a peak occurs, it's there, no averaging possible.

Human hearing has a subconscious 'automatic equalization' feature. If certain frequencies are consistently over-emphasized, the ear gets to ignore this fact after a short while, so the speaker is 'excused' this fault. Amplifiers are not equipped for such 'excusing.' A microphone peak at one frequency may result in overload at that frequency, when other frequencies are well below overload level. While certain voice frequencies may 'blast' the system, the remainder of the same person's audio spectrum may seem inadequate for the system — something for which only the mike can be blamed (unless the individual has a strident voice naturally).

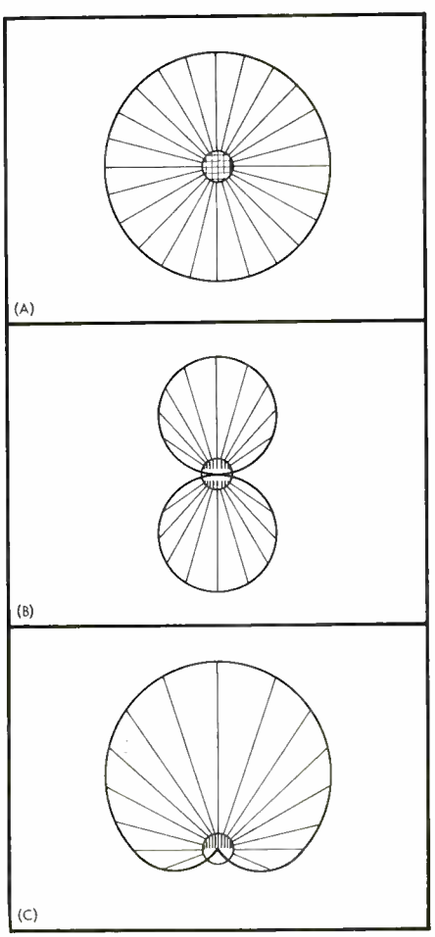

Fig. 6-1. Basic directivity patterns for microphones: (A) omnidirectional; (B) bidirectional; (C) unidirectional or cardioid.

For acoustic feedback, intensity at the offending frequency has to be excessive only at the point in space occupied by the mike, for a howl to start. A similar peak in one, or even all speakers, results in more energy going into the room at that frequency, but the effect may average out to some extent, because of the complicated standing wave field generated. In short, the development of standing waves tends to disguise the speakers' abnormalities in frequency response, but aggravates the same thing in the microphone.

Directivity

A speaker sends out sound waves into a four-dimensional

world of acoustic space—three dimensional waves fluctuating with time; sound going into a microphone enters a two-dimensional world—magnitude fluctuating with time. The acoustic wave enters a 'public domain,' the electrical wave is strictly 'channeled.' So directivity, to control the way in which the electrical wave is derived from the four dimensional world surrounding the microphone, can be very important.

Among the simpler microphone designs there are three types of directivity: (1) omnidirectional, which means it picks up uniformly well in all directions; (2) bidirectional, which means there are two directions of concentrated pickup; and (3) unidirectional, a single direction of concentrated pickup (*Fig.* 6-1). Note that the usable area in front of a unidirectional type is wider than that in front of the bidirectional.

The omnidirectional is best for random, or general pickup, because it has no "dead spots." Both bidirectional and unidirectional are better, each in its own way, for selective pickup. As well as allowing pickup from a greater distance, each reduces unwanted pickup and helps with acoustic feedback problems. Which type is the better to use varies with circumstances.

For dialogue, the bidirectional is useful, because it can be placed between the persons conversing, so each has his own 'live spot.' The participants do not have to adopt a cheek-to-cheek attitude, but can look at each other. However, if they are following a script, the cheek-to-cheek position may be more convenient (they can both read the script, held or supported 'behind' the mike), using a unidirectional mike.

For a single person speaking, the unidirectional is indisputably the best choice. It allows him more freedom of movement without his getting "off mike," and gives much greater pickup range than the omnidirectional. For numbers of people in conversation—plays and the like—one has the choice of individual unidirectional mikes, an omnidirectional mike for the whole group, or an intermediate number of bidirectionals. Each has its advantages, and has to be used with techniques peculiar to it, for best results.

Probably the single omnidirectional mike—or for a large area a few of them—gives the greatest flexibility. But omnidirectionals can only be used where no problem with background noise or acoustic feedback exists. They have greater flexibility because there is no 'overlap' problem, providing they are correctly phased, where more than one is used. Numbers of either bidirectional or unidirectional mikes (particularly the bidirectionals) can lead to overlap problems—certain spots where more than one unit is picking up.

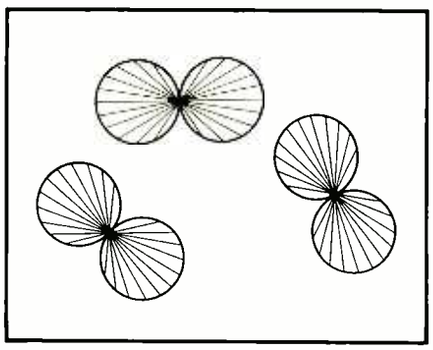

Fig. 6-2. Where directional mikes are used, they should be separated far enough apart to prevent overlap of their effect pickup areas. Then spaces between, where there is virtually no pickup (and what there is will have poor quality) should be avoided.

In general bidirectional or unidirectional mikes should be spaced widely enough apart that their pickup fields do not materially overlap, and the participants should avoid use of those spots that are not adequately covered by any one mike (*Fig.* 6-2). A big help where excessive background or acoustic feedback is a problem, is the use of the electronic quick-fade system, allowing only one mike in use at each instant to be 'live'. This we will cover later.

A trick with bidirectional mikes that has not been used as much as it might be is very useful for amateur presentations: a prompter or director can occupy a 'dead spot' in the acoustic pickup field and give verbal directions or prompts that are quite audible to the participants but not to the microphones. For stage presentations, such 'silent' positions can also be camouflaged visually, so the prompter or director can be right in the middle of things without being either seen or heard by the audience. At first it may be difficult for the players to realize that he is not only invisible but also inaudible to the audience, but once this is realized it can be a very useful trick.

In addition to the more common directivity patterns (*Fig.* 6-1), there are some specially-developed microphones with exaggerated unidirectional pickup patterns. They are more bulky than standard types, but this is no disadvantage, because of their enormously greater range, enabling them to be placed out of sight. One very important thing about them: they must not be obstructed in any way.

I remember one occasion where a store in a noisy location was being pressed into service as a studio for making a short TV film. Knowing my experience with commercial sound, the director called me to know what could be done to eliminate the background, short of acoustic treatment of the place, for which there wasn't time. I recommended use of one of these super-directional mikes and put him in touch with a studio who could lend him one.

After some hours, he called to say he was still having troubles. I went round to investigate and found the mike flanked by a cardboard reflecting cone, to 'augment its effect' (*Fig.* 6-3). I

asked if the mike had been tried by itself without this addition. No, he thought it would be needed, because background noise was so high, so he just went ahead and put it on, 'to save time'.

It took some persuading to get him to remove his ingenious 'reflectors'. When he eventually did, he found the microphone's designer had done a good job; he successfully got his pickup, with very little background interference. So don't try to improve on the work of acoustic designers—especially in dealing with microphones—it's a specialized job and they know how to build a mike to do its job right without extraneous help.

Phasing

This doesn't normally arise with microphones, because usually only one mike picks up any one sound. But in some commercial sound systems, where reliability is extremely vital, the customer may require a standby microphone in position, as a safeguard against microphone failure in the middle of a program. If the standby mike is left inoperative until needed, there is still no phasing problem. But if both mikes are 'live' at once, phasing is important, whatever type of mike is used. Incorrect phasing will cause partial cancellation at some frequencies, resulting in a very peculiar sound quality.

This is also true where mikes are more widely spaced, if overlap of pickup area occurs.

Type of Microphone

Not a few professional people, who have no knowledge of circuits, judge microphones entirely by type: moving coil, ribbon, condenser (or capacitor), crystal (or ceramic), or "magnetic" (also known by various other names, such as 'moving iron', 'variable reluctance', and so on).

The condenser or capacitor type invariably carries the highest price tag and many think this means it has the highest quality, which is not necessarily true.

More important than which type of transducer it is, are the questions relating to how well it fits into the system in various ways. Each has certain characteristics of impedance and level, variety of patterns available (in directivity) and quality and stability of frequency response.

For many years the best omnidirectional mikes were of the condenser type, but their high cost is not related to their superior performance. The main reason for the higher cost is the associated equipment: polarizing supply and head amplifier or impedance changer, in miniaturized form, that have to be attached to the mike. On most scores, all this extra electronics, hanging onto the mike, is a disadvantage rather than a merit.

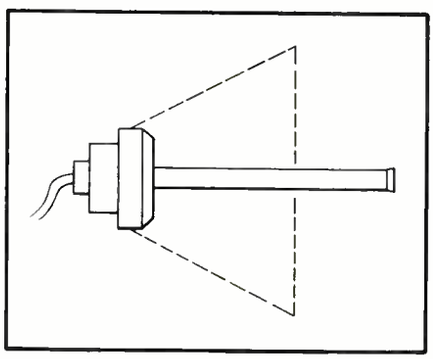

Fig. 6-3. A mistake not to be made in using superdirectional mikes. The dashed lines represent a cardboard cone that an uninformed enthusiast put around it to 'help'; actually, presence of the cone destroys the mikes natural high directivity.

In the same early days, the only kind of directional mike was the ribbon, which was approximately bidirectional. Its clumsiness made its quality poor, but its directivity, where needed, outweighed its quality deficiency. Modern ribbons may be either bidirectional or unidirectional, and their quality is second to none. Intrinsically they are more fragile than other types, but a ruggedly designed ribbon can be better in this respect than a poorly designed mike of any other type.

In recent years, moving coil mikes (which were the poor relations in the early days) have approached the performance (providing you get a good one) of condenser types at very much lower cost and with much greater reliability. They were among the early entrants for unidirectional (also known as cardioid) and were not very good at first. But later models achieve extremely good response, with a good directivity pattern to go with it.

Crystals, or the more recent ceramics, are much less costly than moving coils and generally inferior in performance, although high in sensitivity. But some of them are quite good and a good ceramic may easily be a 'best buy' for systems in which they can be used. Again, there is no definite relationship between quality and cost, although usually the superior engineering which results in better quality will demand a higher price.

Magnetic, or whatever other name it goes by, is almost inherently an inferior type, but it has the advantage of high sensitivity which makes it attractive (like the low cost ceramics in this respect) for low cost, small installations.

Virtually all types of microphone are now made with all types of directivity pattern, although there are strong trends to stay with the pattern more or less natural to a type. Most of the inexpensive types are virtually omnidirectional, although the frequency response is much better from the front. Inexpensive bidirectional (ribbons) are reasonably good—they cannot help having their characteristic figure 8 pattern. Cheap cardioids are usually a poor buy: their frequency response is poor and the rejection at the back very erratic in frequency characteristic.

Question, Chapter VI

So much for types in general. Next installment will go through the question of impedances and methods of connection and various other aspects of input circuits. The best systems will demand a professional microphone, which invariably costs more, while smaller systems can adequately use a less expensive type. Is the principal distinction one of (a) quality (frequency response, and so on), (b) impedance of connection, or both?

Answer—Chapter VI

A professional microphone (unless it is a cheap one for which the advertising merely *claims* it to be professional, which does happen) has both these differences. Its frequency response is closely controlled—every unit made will have its response checked to a standard before it is allowed to leave the factory—so it will invariably be smoother than the less expensive model even though the two look almost identical. It will also have more rugged termination and standard connectors of one or other professional variety (usually to customers' requirement, but most manufacturers have their own standard where the customer does not specify). All professional mikes have an output impedance of one or other standard line rating, while non-professional mikes are either low or high. Some mikes, to bridge the market, have alternative impedances, including line as well as high and low. All this we will discuss more fully in the next installment.

Hi Fi and the British: Privacy

ALAN WATLING

OUR HOME BEING OUR CASTLE, be it country mansion or semi-detached (a typically British word meaning a house sharing a paper-thin wall with another one), a tremendous value is put on Privacy. A motto might well be hung on every wall; "Thou shalt not hear thy neighbour's Woofer"—or his TV, or his madrigal session, depending on the district. We have yet to extend this tribal taboo to the Great Outdoors, as transistor portables now invade our parks, beaches and other marital hunting grounds. Fear not, it will be done. If only by the judicious use of transistorized signal generators hidden in picnic baskets.

As we have a small island and rather a lot of semi-detacheds, the proportion of enthusiasts who can afford the luxury of actually using fifty American watts is also small. We have, therefore, a native interest in reducing Resonance in Hollow Floors, Chestiness, and Ear-piercing Top. The emphasis this year is on mini-speakers and Cassius cabinets (with the lean and hungry look). On the credit side, this gracious way of living encourages sensitive speakers for low outputs, "open" sound and a pathological hatred of Boom. The glorious prospect of personal Arctic isolation has bounced headphone sales—I started this way in my high chair and have a daguerrotype to prove it —and some people now actually claim to hear what is coming out of their amplifiers. Cynicism will get you nowhere, say you . . . There should be a knob, say I, marked "% Distrust," and another marked "Absence." Intelligent use of both of these will eliminate neighbour crosstalk—and the need for the other knobs.

Resonance

Open Sound

So now you've sent us Background Music. Yes, you, with the American accent. This mental wallpaper attacks privacy on a bold non-partisan front. Eat out, you get it. Shop in the big stores, you get it. Go to the airport to flee, you get it. A treacly, predigested, non-stop, meandering threshold level of paperback pulp on slow-slow tape drips from the wall-boxes. When there used to be a restaurant orchestra at least you had the thrill of waiting for the violinist to dip his bow in the gravy. Now there's only the forlorn hope that the 4800 feet of four-track Mylar will wrap itself around the capstan.

Now that sounds a trifle bitter. Perhaps it's because I'm using my neighbour's typewriter and he is a schoolteacher. They just don't understand the need for mass anaesthesia.

Reverting to the topic, the original fear that stereo would blast away the remaining bricks that separated us from the next door has not been realized. For one thing, operating each speaker at half the level has been kinder to the eigentones that worried us when all the watts were coming from one corner. For another, many of us (not all, by any means) have found that directional speakers give more accurate stereo positioning. Ergo, less splashing around of the Brahms. For yet another, it has been proved conclusively that for the best stereo effect your chair must be arranged in a triangle and the room must be asymmetrical with no doors.

And what could be more private than that? Æ

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JENSEN DCA SERIES loudspeakers offer exceptional flexibility, not readily available heretofore. Here's still another way that every sound specialist can offer a *better* sound system worth more to the end user.

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Optionally available with dual 8-ohm, dual 70-volt or dual 25-volt input. Interconnect voice coils for regular 4 or 16-ohm operation.

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TECHNICAL SPECIFICATIONS

DCA-850		DCA-830
8-inch	Nominal Size (Diam.)	8-inch
8/8 ohms	Nominal VC Impedance	8/8 ohms
12 watts	Power Rating[1]	10 watts
30-12,000 cps	Response Range	30-12,000 cps
90°	Coverage Angle	90°
83.0 db.	Sensitivity[2]	82.0 db.
—18 db.	Crosstalk	—18 db.
70 cps	Resonant Frequency	70 cps
10 oz. SYNTOX-6*	Magnet	4.8 oz. SYNTOX-6*
1"	Nominal VC Diam.	1"
8⅛" O.D. x 3" D.	Dimensions	8⅛" O.D. x 2 1⅜₆" D.
6¾"	Baffle Hole Diam.	6¾"
2 lb., 6 oz.	Net Weight	1 lb., 10 oz.

1. Maximum recommended speech and music level as indicated by standard VU meter (peak power is substantially higher).
2. Axial free field sound pressure level (re .0002 dynes/cm²) at a distance of 10 feet for an input power of 1.0 watt 800-1250 cps warble band.
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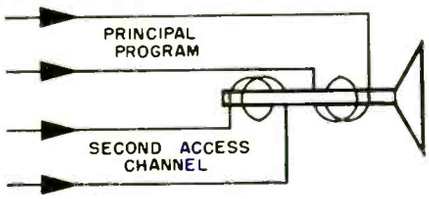

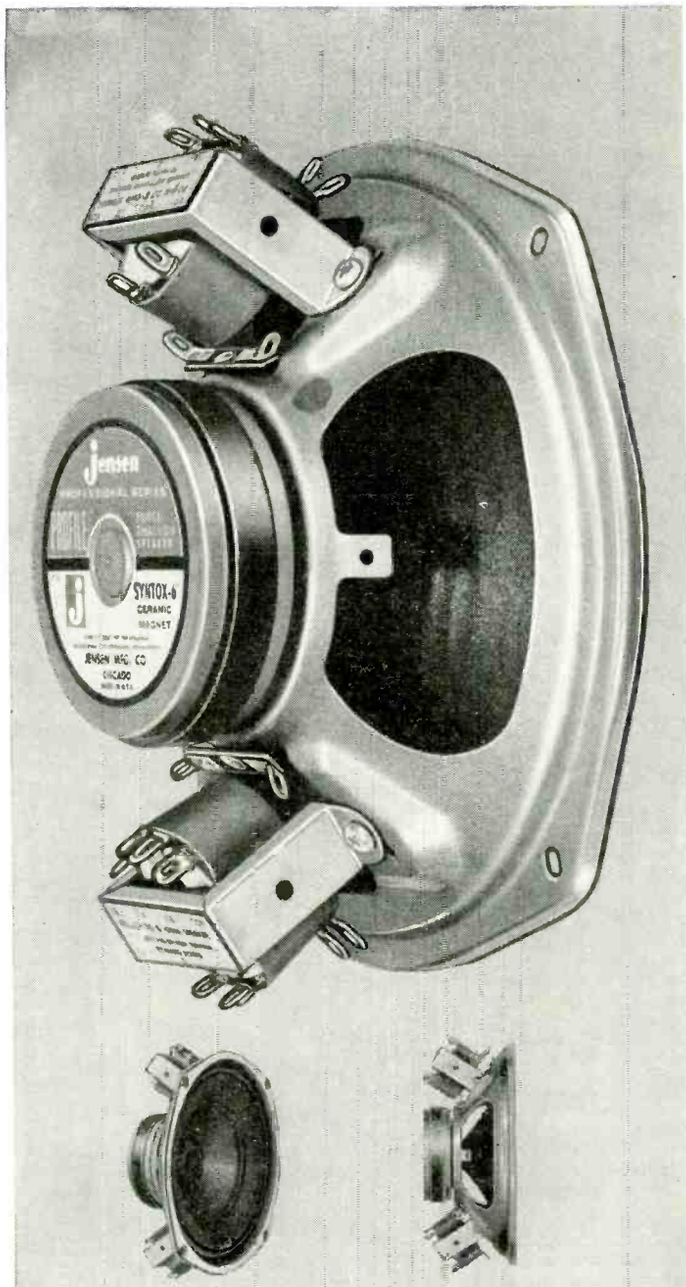

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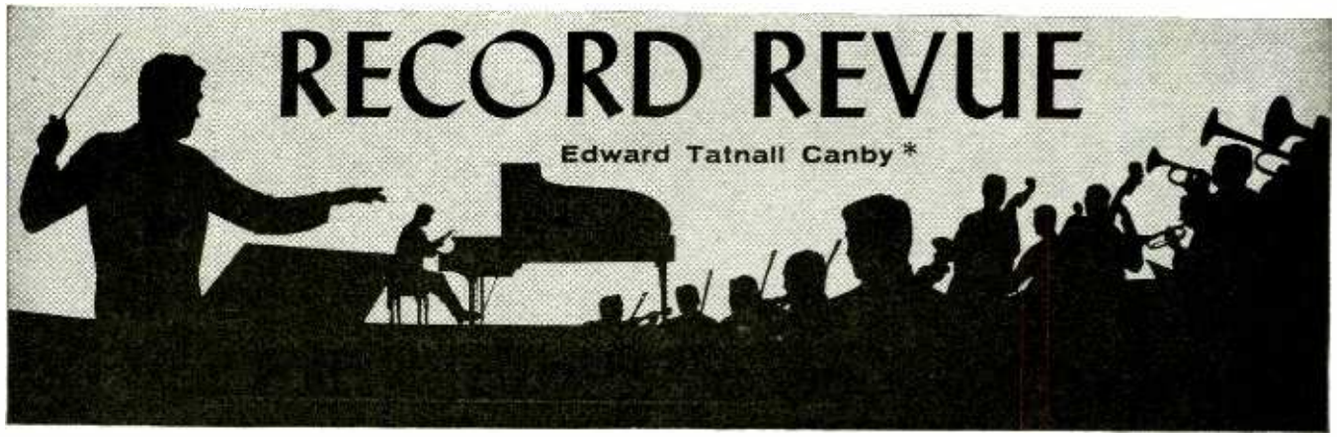

RECORD REVUE

Edward Tatnall Canby *

DISC CUTTING—1950–64

Haydn: Orfeo ed Euridice (L'anima del filosofo). Handt, Hellwig, Poell et al.; Chorus, Orch. Vienna State Opera, Swarowsky.

Vox OPBX 193 (3) mono

It was a very enlightened self-interest that prompted Vox to reissue this six-sided mono opera LP after some 14 years, the only recording ever made of Haydn's late and unperformed masterpiece of 1791, his last opera. The tapes are those of the Haydn Society, made in 1950 after long and extensive research to assemble the fragments of the opera. I have the original Haydn Society discs, long since out of print—I've made AB comparisons and am amazed. From the very same tapes, the Vox discs are extraordinarily improved, reflecting the immense strides in the technique of disc cutting since 1950.

We've always known that our early tapes were mostly far ahead of the LP discs that could be made from them. Here, the difference is audibly measurable. Many an innovation since 1950 adds cumulatively to Vox's triumph with this unusual album. For instance, variable groove spacing "shortens" Vox's sides, allowing a higher recorded level (as I found by direct comparison) while reducing the inner-groove problem. The 1964 surfaces are astonishingly improved, too, velvety-silent compared with the pops and clicks of the old discs. (Do these grow worse with time on an *unplayed* disc? An interesting question which might apply here.)

But more important is the astonishing improvement in the over-all "fi" on the new discs. On the original records the solo voices sound harsh and edgy throughout, especially the all-important voice of the tenor solo, Orpheus. On the new discs he is magically transformed. The vocal sound is now soft, natural, virtually distortionless even in the loudest passages.

This significant difference would seem to be largely that of intermodulation generated in the old cutting, perhaps with other distortions mixed in. Was the hot stylus in use as early as 1950–51?? Probably not in the Haydn Society cutters! We have here, I'd guess, an accurate reflection of the then still unsettled microgroove cutting process, not yet well controlled after the changeover from the relatively coarse 78 cutting of the past.

Other minor details help the new discs—RIAA curve (the old discs are clearly cut to a different curve), raised-edge lead-ins (in 1951 not yet introduced by RCA), protective inner sleeves (the old discs were shipped out naked in their pockets). A lovely price differential too, of course. Vox has retained the gist of the enormous Haydn Society booklet, including the complete libretto in Italian and English.

HIGH BAROQUE

Handel: Water Music (complete, ed. Boyling). Bath Festival Orch., Menuhin.

Angel S 36173 stereo

Händel: Wassermusik (complete, ed. Arnold). Berlin Philharmonic, Kubelik.

D. Grammophon 138799 stereo

We must credit the LP record with having rediscovered the complete Handel Water Music, a dozen and a half pieces covering two full microgroove sides. The LP is voracious. Previously, the numerous "Water Music Suites" taken from the complete work centered upon only six movements, short enough for a modern symphony-concert item or for a 78 rpm album. No good on LP! So here are the two latest complete stereo versions, enough music to fill two sides nicely. One is from merrie England, the other straight out of Berlin, with a Czech-born conductor. Nice contrast.

They are mostly the same in content but not quite. No score exists of the original—if and when. It isn't absolutely sure upon what watery occasion the music was played for King George from a barge floating in the Thames river. Handel revamped the score, as he often did, for later uses of varying sorts. (Indeed, four movements were borrowed from previous works of his.)

The instrumentation is far from definite, either. The erstwhile suites of six movements were rewritten to suit the modern symphony orchestra; Sir Hamilton Harty's was the best version. (Others, I'd guess, were just different enough to avoid copyright problems.) Handel changed his own original, fixing it up economically for dry-land use. (He added a harpsichord-or-organ continuo part, there being no harpsichords and organs on river barges.)

Still further, there were customary ad lib cadenzas, inserted by the performers. (You'll find some in these recordings. Very nice.) And our new understanding of Baroque rhythms has led to some drastic changes in the "French overture" opening movement, as heard in both these versions. Double-dotted. All in all, what with varying ideas as to the assorted dance-rhythm tempos, depending on the conductor, each new "Complete Water Music" is a law unto itself. Never know what you'll find.

The German recording here is the more polished, the more accurate in performing ensemble, rather intense and driving in the big movements, lovely in the slow parts. It's from a late-Eighteenth century edition. The British version, under that Britisher-by-adoption, Yehudi Menuhin, is more intimate and a trace stiff in the playing, very slightly ragged in ensemble here and there. But the dance rhythms are hearty, especially in such British-style Handelian dances as the Hornpipe, which will be forever a bit beyond a German player's ear! It is a drier, closer recording than the mellow Deutsche Grammophon offering.

Handel: Four Concertos with Oboe. Cento Soli Orch., Anthony Bernard.

Nonesuch H-71013 stereo

These new Nonesuch low-priced LP's (from Elektra) come in stereo or mono at the same price. That makes the stereo a special bargain, with the one-dollar premium removed. (Big companies still hold out but a number of the enterprising lesser-sized outfits are coming over to the one-price system. Stereo users please note.)

Handel was the most British composer imaginable, out of his own sheer cleverness. And so it is always interesting to hear his music performed by continental players. This is a fine French orchestra, heard before on records (notably on Omega stereo around 1959). It plays with crisp and business-like intensity, with the characteristic bright French string sound and sharp-edged woodwind tones. Lots of expression but not a bit sentimental. A pleasure after much British-based Handel.

Bach: Magnificat in D. Stich-Randall, Casoni, Bottazzo, Littasy, Cho. (and Orch.) Sarrebruck Conservatory, Schmolzi.

Bach: Cantata No. 51, "Jauchzet Gott." Teresa Stich-Randall, Chamber Orch. of the Sarre, Ristenpart.

Nonesuch H-71011 stereo

Here are two really first-rate recordings of Bach at a bargain price, mixed German-Italian performances from the Sarre, on the borders of France. (The tapes are French.)

The famous cantata for solo soprano, No. 51, features a brilliant trumpet obbligato pitted against the solo voice. It is sung here with astonishing expertise and musical perception by the excellent Teresa Stich-Randall, who can turn on, whenever she wishes, that curious "little boy" tone that we find among German sopranos (notably Irmgard Seefried)—each note sung precisely on pitch and with virtually no vibrato at all. She can run off rows and rows of rapid scales and arpeggios, too, with instrumental precision to match the trumpet part and a pair of solo violins. Exactly what is needed: the music was composed for a boy soprano.

The "Magnificat" is a lively, sincere performance with a fine student chorus (sounds like boys' voices on top) and a well-balanced group of soloists, all musical and only moderately clumsy (who isn't?) in the difficult vocal parts. Few better Bach recordings at any price, I'd say.

Bach: Cantata No. 51, "Jauchzet Gott"; Suite No. 1 in C. Judith Raskin; Festival Orch. of N. Y., Thomas Dunn.

Decca DL 710089 stereo

Here's a New York performance of the same cantata, coupled with the Suite No. 1 for orchestra. Both are subtlely New York in style—how quickly the New York way of performance tags itself on records in contrast to continental ways of music-making!

New York playing (and singing) is relatively tense, hard, high-strung, its teeth a bit on edge. There is a curious sense of hurry (even when the music is slow), an inner tension that is not in the music but in the players.

Thus though the Cantata is well played and well sung, if without much inner perception, it somehow has a bit of the hard New York drive to it and the orchestral Suite has much more of the same. No poetry. Judith Raskin is an excellent modern soprano who sings the

incredibly demanding runs and roulades, the long-breathed phrases of Bach's vocal line with competence and good musicianship but with no special talent for this very special kind of vocal music. Her main trouble, entirely normal, is a vibrato that blurs the intended accuracy of the rapid notes and spoils the duet-like play between solo voice and solo instruments.

Stich-Randall, on Nonesuch (above) does it much better—a superb re-creation of the Bach singing style itself. She sings rings and roulades around Raskin.

Telemann: Concerto Grossi No. 1 & 2-Overture. Orch. of the Sarre, Ristenpart.
Counterpoint-Esoteric 5612 stereo

Bach: Violin Concertos Nos. 1 & 2; Double Violin Concerto. C. Croulnik, G. Armand, vls., Toulouse Symphony, Auriacombe.
Counterpoint-Esoteric 5610 stereo

The first of this pair has more of the excellent Sarre music-making under Ristenpart, on a different label. Unusually well played Telemann and nicely recorded too. The second disc offers some good Bach, if a bit heavy-handed for today's nervous tastes, by two fiddlers and an orchestra quite unknown to us hereabouts and a conductor the same. Probably very well known in their home country. A lot of recorded pleasure here for a modest price.

Now if only Everest-Counterpoint-Esoteric (all the same company) would get somebody to fix up their labels and jackets! It's *concerti grossi*, not *concerto grossi* . . . . and the proper term is either the old *Ouverture* or else the now-common *Suite for Orchestra*. And one customarily gives the key of the piece, like for instance E minor or what-have you. (I.e. the Concerto in D Minor for Two Violins.) 'Nuf said. The music here is jes' fine and dandy.

Bach: Three Gamba Sonatas. Milton Thomas, viola, Georgia Akst, piano
Concert-Disc CS 242 stereo

Should Bach be played on the "wrong" instruments? Well, it all depends.

Here we have a viola subbing for the original viola da gamba (a bigger, cello-sized instrument with a high tenor voice) and a piano taking on the harpsichord role. What matters first, of course is the musicianship of the performers and here there can be no complaint. They both play Bach very musically, with good understanding of harmonies and rhythms.

And yet—for those who know the original sounds there are unpleasant side-effects. Inevitably, the piano sounds bouncy, percussive and thin. It always does in such music. The viola is much better, since its tone is only moderately unlike that of the gamba. In the over-all, there is a shallowness of tonal impact, an unevenness, that is not good.

The original sound, with harpsichord, is much bigger, broader and, above all, smoother with a blending of the two instruments, where here they compete tonally. And, inevitably too, there are the casual wrongnesses of ornamentation that go with piano Bach and more or less have to—since the piano doesn't sound right in the Baroque-style turns and trills.

Bach is big. He'll survive all sorts of transcribing and arranging, as we know. He survives very nicely here.

MIDDLE BAROQUE

Baroque Music in Salzburg. (Heinrich Biber, Georg Muffat.) Concentus Musicus, Vienna.
Bach Guild BGS 70652 stereo

Funny how our increasing interest in older music brings out "unknown" composers like, say, this man Biber ("Bee-bare"), whose name I had never even heard until a year or so ago when Cambridge Records brought out the splendid album of his "Scordatura" violin sonatas (i.e. with violin tuned abnormally).

(Continued on page 58)

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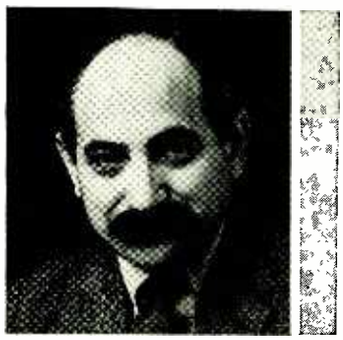
Circle 123 on Reader Service Card

JAZZ and all that

Bertram Stanleigh



Mexican Folk Songs

At Mastertone Studios, just off of New York's Times Square, I recently looked in on a recording session of Monitor Records, a firm whose reputation is based on its catalog of international folk music. A collection of popular Mexican folk songs was in the process of being committed to tape, with Maria Luisa Buchino as soloist. Senorita Buchino and her trio had already waxed two successful Latin American platters for Monitor, and a Mexican disc was scheduled with the same forces. When the well known guitar trio, Los Aguilillas, arrived in New York on a concert tour, it was decided this group would be used in the project. The sounds emerging from the monitor speakers when I arrived, were a strong confirmation of the suitability of this instrumental contingent.

During my visit to the session, four songs were recorded: *Guadalajara, La Media Vuelta, Nunca,* and *El Son de la Negra.* In three of these, Senorita Buchino was accompanied by a quartet of guitars and a *guitarron* (a bass guitar which I had previously encountered in the same studios at an Elektra session). For the fourth number, one of the guitars was replaced by a smaller instrument of the same shape, called a *raquinto,* whose sound was somewhat like that of a mandolin. Other tracks, recorded before my arrival, included a small Mexican harp, and a subsequent session was to include a trumpet and fiddel in the accompaniment.

Two recorders were in operation, a two-track and a three-track Ampex. The two-track tape is used as a master, and the three-track version is retained as a safety, in the event that later listening determines a need for rebalancing. Four microphones were used, Neumann U-67's for Miss Buchino's voice and the voices of the guitarists, who also provided the chorus, an RCA 44 BX ribbon to provide good low-frequency response and a mellow quality for the four guitars, and a Schoeps M221 picked up the sound of the *guitarron.* Additional echo for the voices and the guitars was provided via an EMT reverberation unit. The group was deployed in a triangular formation with the soloist approximately ten feet from each of the instrumental units, and the guitars and *guitarron* about six feet apart (See *Fig.* 1.)

Mrs. Rose Rubin of Monitor maintained watchful supervision, while A & R chief, Michael Stillman, directed the session. The engineer was Sid Feldman. Maria Luisa Buchino was in fine voice, the instrumentalists worked smoothly together, and Sid Feldman managed to achieve a sound balance that pleased all parties. There was no feeling of rush; indeed, the easy, relaxed pace at which everything proceeded made me curious as to the number of sessions they expected to employ. Stillman assured me that two would suffice, and Mrs. Rubin added the information that in all of his recordings, both here and abroad, Stillman had never required more than two sessions to complete a platter—with no compromise in standards.

Fig. 1. Miss Buchino sings, accompanied by Los Aguilillas and guitarron.

As the session continued, it became clear that Stillman's unhurried manner was based on a thorough knowledge of his performers and their music. Nothing escaped his attention, but his affable manner kept everyone in a happy frame of mind, and prevented the jitters that often result in clumsy openings or ragged endings. Except in those instances when a start was poor, he allowed each take to go on until its conclusion, or until the performers themselves called a halt. His philosophy was summed up when he said, "Let them do it their way; they know best." Actually it was Stillman who knew best, and his skill in getting his message across is an important contribution to this forthcoming platter. Rather than interrupt a poor take, he waited until the next take was to start, then gently suggested that the musicians retune.

My interest in this session was particularly keen because this was my first chance to hear Mastertone's large studio since it had been renovated. Previously this had been an extremely dead chamber, lined on ceiling and all walls with glass wool. It had been decided that a more live sound was desirable, and the walls had been relined with an array of wood and cloth-covered glass wool panels that can be interchanged to vary the rate of absorption. Special acoustical panels were used on the ceiling. One auditioning is hardly adequate for making a firm judgment, but it is clear that there is a more spacious quality, better instrumental definition and a more solid feeling to the bass.

While the final test of both the sonics and the performances must wait the arrival of the finished disc, the impressions gained from playbacks at the session suggest that Monitor has another success on its hands.

JAZZ REVIEWS

Duke Ellington & Billy Strayhorn: Great Times!

Riverside Mono 475

Recorded in 1950 by Duke's son Mercer and critic Leonard Feather, these piano duets are a rare and rewarding bit of Ellingtonia that will be prized by all collectors. Indeed, eight of these selections were originally available on the short lived Mercer label as a ten-inch long player that has since become a valuable rarity. The performances represent the intimate collaboration of two men who have worked together since the late thirties. With the exception of *Tonk*, all of the numbers are strict improvisation without any advance planning, but they have about them the close knit, smoothly worked out detail generally confined to meticulous arrangements. No doubt much of this result is due to the pieces chosen. They represent many of the outstanding achievements of the Ellington-Strahorn team: *Cottontail, C Jam Blues, Perdido, Take The 'A' Train* and *Blues for Blanton*. But there is none of the quality of four hand arrangements of orchestral pieces about these performances. These are fresh, original approaches to these old standbys. The problem of reissuing this material was considerably more difficult than the usual procedure with modern taped performances. Most of the original tapes had been destroyed by fire. Metal mothers supplied some of the numbers, others were dubbed from borrowed pressings of the original release. The result may be slightly less than super high fidelity, but quality is entirely satisfactory.

The Double Six of Paris Sing Ray Charles
Philips Stereo PHS 600-141

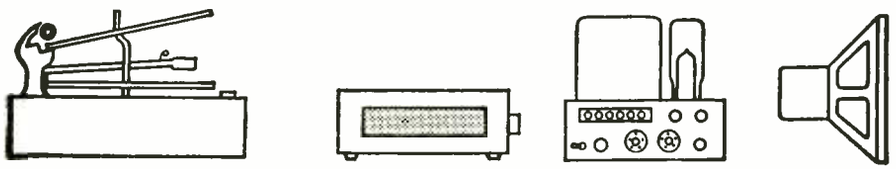
Backed by the lively Jerome Richardson Quartet, the Double Six offers eleven tunes that have been associated with blues singer Ray Charles—a rather contrived gimmick on which to assemble an lp, particularly since there is hardly a close relationship between the styles of Mr. Charles and the Double Six. Happily, Ray Charles has included a substantial group of material in his repertoire that is well suited to the ministration of the Double Six. Among their offerings are *One Mint Julep, Yes, Indeed, Georgia on My Mind, Hit the Road, Jack* and *Ruby*. In each number the group employs its now familiar technique of employing its voices as though they were instruments, with words largely replaced by scat syllables. Generally the title of the tune is sung in English with the balance of the lyrics consisting of dooh-wah dooh-wah. The arrangements have been carefully tailored to show of the technique and musicianship of the talented Frenchmen, some of whom are also members of the Swingle Singers. It is quite possible that the present record will take off and achieve the same widespread recognition as the recent Swingle hits. The recording quality is on a par with the vocal technique—perfect.

Bola Sete: Tour de Force

Fantasy Mono 3358

Brazilian guitarist, Bola Sete, whose appearances with both jazz and bossa nova groups has already demonstrated his versatility, is represented in a solo recital that runs the entire gamut of Western music. A Bach *Bourée*, Henry Mancini's *Moon River*, Dizzy' Gillespie's *Tour de Force*, Luis Bonfa's *Samba de Orpheu* and Isaac Albeniz' *Arturias* are just five of the ten numbers that make up this recital. In spite of the variety of material, Sete's strong musical personality is dominant, and there is a satisfying feeling of unity about this disc. An able, rather than phenomenal technician, Bola Sete is one of those rare musicians who plays as naturally as he breathes. No detail ever obscures the overall design of his performances. Never is there a rhythmic lag, yet there is a feeling of poise, almost of hesitation at many points in these performances that contribute greatly to their elegance. This is a record that grows in one's estimation with each replaying. As in all waxings of unamplified guitar, there are some minor mechanical sounds, but careful mike placement has minimized their intrusion.

EQUIPMENT PROFILE



AMPEX PORTABLE STEREO TAPE RECORDER, MODEL 2070

The Ampex Model 2070 is a self-contained stereo reel-to-reel tape recorder designed to offer the easy-loading convenience of a cartridge machine with the flexibility of a reel-to-reel machine. In addition there are several technical innovations which make this machine interesting from any viewpoint.

The first, and most striking feature, is automatic threading. One glance at the top of the machine reveals that there appears to be space for only one reel; in the place where the take-up reel would normally be we see a flat surface with a slot in it. The clever visual design points the way: one merely takes the tape from the supply reel, places it in front of the head as usual, then places it in the slot, and the machine does the rest. Not only does it thread itself on the special reel concealed beneath that flat surface, but the machine will automatically reverse the tape direction at the end of the reel, *or whenever you want it to!* And then, if you want it to, it will shut itself off.

The reversing command is placed on the tape by the machine itself and consists of a low-frequency tone which sets off a chain of circumstances which ends up by reversing the motor. Yes the motor is electrically reversible. The built-in low-frequency oscillator may be actuated to place its command signal anywhere you desire on the tape.

As far as ease of operation is concerned, we must admit that the 2070 (and its 2000 series family) is the easiest to operate we have experienced in some time. It can be operated easily with one hand. The only thing we found fault with is that there is no indicator to show when the machine is on or off. The machine is turned on by lifting the tone control knob about ¼-in. Unfortunately, because of the handsome visual design, it is very easy to overlook the fact that the knob is raised, and there is no other visual indicator of on-or-offness.

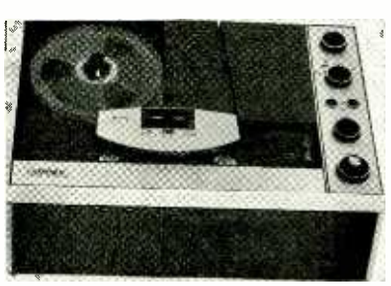


Fig. 1. Ampex Stereo Tape Recorder, model 2070.

Although the 2070 plays back, mono or stereo, in either direction, it records in the forward direction only. It uses three heads to record 4-track stereo or mono and play it back. Head one is for playing back tracks 2 and 4 (reverse direction), head two is the erase head, head three plays back tracks 1 and 3 (forward direction) and records all tracks. The heads are mounted on an unusually rigid die-cast and machined block which is securely and accurately mounted to the die cast and machined main chassis.

In keeping with its professional head assembly, the 2070 uses tape lifters and pressure rods (*not* pressure pads) similar to the ones used on the Ampex 300 (scaled to size of course). Seem to be made of the same milky-white glass-like material. The tape guiding system is appropriately accurate.

The Drive System

Close examination reveals a highly unusual system for driving the tape past the heads: there are *two* capstans, one at each end of the tape head block. This short, tightly controlled path past the heads insures precise tension and speed control. In fact, as the performance data will reveal later, this machine has the lowest flutter we have encountered in a tape recorder designed for this purpose (professional recorders *may* have lower flutter).

The single-speed, electrically-reversible motor has a three-stepped pulley for driving the capstans, plus another pulley for driving the reels. The capstan pulleys drive a belt which loops about the *two* massive flywheels used to drive the capstans. An x-ray view from the top would show the belt in a roughly triangular shape, around the motor pulley at the apex and around a flywheel in each remaining corner.

The tape reels are also driven by a belt system, which derives power from a pulley on the motor shaft. This belt goes around three idlers, two of them are close to the tape reels and mounted on an arm which permits these idlers to contact the respective reels for fast forward or reverse. Ordinary speed is imparted through a large diameter wheel below the reel which is brought into contact with an appropriate surface on the idler.

The drive system is both simple and rugged. Our guess would be that it will hold up extremely well, and with little, if any, trouble.

We are unable to describe the electronics of this machine because a schematic was not available at the time we tested it, at least not to us. However, we can note that it is a tube circuit.

Performance

An interesting facet of the performance specifications given by Ampex is that they publish two sets: average and guaranteed minimum performance. We found that all our readings came closer to the average rather than the minimum value. With the reputation of Ampex, it is exactly what we would expect.

The frequency response at 7½ ips was within 2 db from 30 cps to 17 kc; at 3¾ ips within 3 db from 45 cps to 12 kc; at 1⅞ ips within 3 db from 50 cps to 5.5 kc. Signal-to-noise ratio at 7½ ips was 51 db, at 3¾ ips it was 46 db, and at 1⅞ ips it was 42 db. Total flutter and wow at 7½ ips was 0.07 per cent at 3¾ ips it was 0.14 per cent, and 1⅞ ips it was 0.21 per cent. As we noted before, this flutter reading is excellent. The speed accuracy at 7½ ips was within 0.5 per cent, at 3¾ ips it was within 0.8 per cent, and at 1⅞ ips it was within 1.9 per cent.

Power output from the built-in amplifier was 8 watts rms per channel.

The Ampex Model 2070, and its related brethren in the 2000 series, are obviously excellent machines at a modest price. You'll be quite pleased at its ease of operation as we were, but its best quality is performance. **Circle 160**

BARKER & WILLIAMSON DISTORTION METER AND VOLTMETER, MODEL 410

Distortion is that quality which a high fidelity product should have none of. Of course even the world of high fidelity is not perfect so we must settle for the lowest distortion we can achieve.

The B & W Model 410 distortion meter is a high quality instrument designed to tell us the distortion level we have

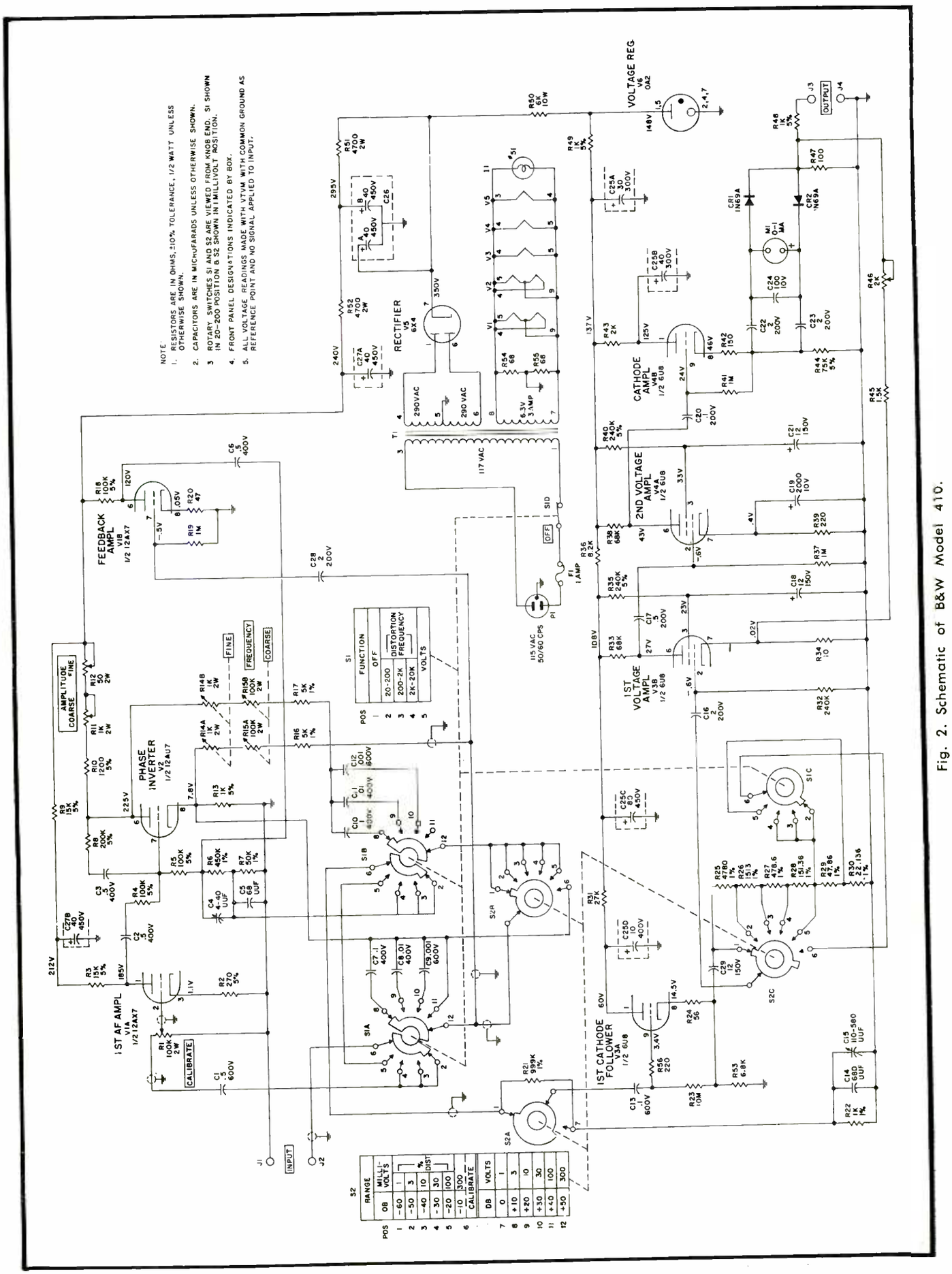


Fig. 2. Schematic of B&W Model 410.

achieved. In addition, it is also a very fine a.c. VTVM which measures rms voltage from 0.0001 to 300 volts, independent of frequency from 20 eps up to 200 kc. Of course, the voltmeter also reads db with a range from −75 to +52, or 127 db.

Adding up its various parts we end up with an instrument capable of being used for a variety of audio applications in addition to the ones mentioned: It can be used to measure noise levels of audio amplifiers; modulation of transmitters; as an amplifier for low-level a.c. signals (a 1 mv signal can be amplified 200 times); single-frequency filter from 20 eps to 20,000 eps; a null indicator; and so on. Most important, it performs all these functions with accuracy and reliability.

Distortion Meter Circuit

The Model 410 has a highly-selective Wien bridge to "notch" out the fundamental frequency of the test signal, a sensitive a.c. amplifier to amplify the harmonics, and a meter circuit to read percentage distortion. Here's how it works (see *Fig.* 2):

The signal is first applied across the CALIBRATE pot, R_1, through C_1. R_1 attenuates the signal to approximately 100 mv before it is applied to the first amplifier tube V_{1A}, where it is amplified 10 times and applied to the grid of the phase inverter tube, V_2, through coupling capacitor C_2. This amplification is necessary to provide sufficient signal level to overcome any hum or noise that might be present in the nulling circuit. With RANGE switch S_{2B} in CALIBRATE position, and FUNCTION switch S_1 in one of the distortion frequency positions, V_2 operates as a cathode follower rather than a phase inverter. Now the signal through V_2 goes to feedback amplifier tube V_{1B} and on to a reference point between resistors R_5 and R_6. At this point the signal represents a gain of 1 compared to the signal at the grid of V_2, which means that if the fundamental frequency is eliminated between V_2 and V_{1B}, the signal at the reference point will consist of the harmonics only, and the amplitude of the harmonics will be the same as at the gird of V_2. The tunable Wien bridge "notch" is brought into the circuit when RANGE switch S_2 is set at a "% distortion" position. The frequency range of the bridge circuit is determined by C_7 through C_{12} which are selected by FUNCTION switch, S_1. The normal response curve of a Wien bridge circuit is much broader than required for this application so that a large amount of negative feedback is applied from the plate of V_{1B} to the grid of V_2. This provides a sharp notch at the fundamental frequency.

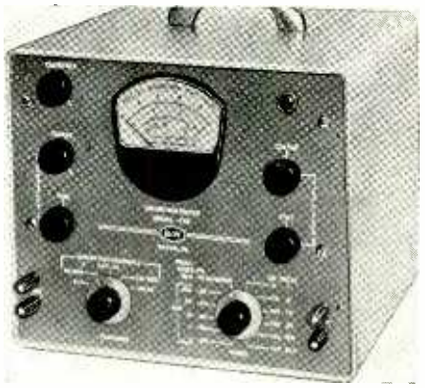


Fig. 3. Barker & Williamson Distortion Meter and Voltmeter, Model 410.

The rms value of the signal used as 100 per cent reference is approximately 1 volt, and the voltmeter sensitivity at 100 per cent distortion position is 100 mv, so that it is necessary to attenuate the signal to about 0.1 of its normal value by means of R_6 and R_7 before it enters the meter circuit.

Voltmeter Circuit

The input signal is applied across an attenuator, R_{21} and R_{22}, when the function switch is in VOLTS position. Attenuation is 1000 times to prevent signal level exceeding 300 mv at the grid of cathode follower V_{3A}. The gain at this tube is approximately 0.95. The signal then goes to the junction of R_{24} and R_{53}, and from there through coupling capacitor C_{29} to the attenuator, R_{25} through R_{30}. RANGE switch S_{2C} is adjusted so that the rms value at the grid of V_{3B}, the first voltage amplifier, does not exceed 1 mv, the value which produces full scale deflection of the meter. The signal is then subjected to a net gain of 55 db by the time it reaches the junction of R_{42} and R_{44} in the cathode of V_{4B}. The signal then goes to the rectifier-bridge circuit consisting of C_{22}, C_{23}, CR_1, and CR_2. A pulsating d.c. is applied to the milliammeter. At the same time a.c., from the output of the bridge, is applied as feedback to the cathode of V_{3A} through R_{45} and R_{46}. R_{46} is adjustable to vary the gain of the amplifier. The a.c. output of the bridge circuit is also available at the output jacks.

The power supply consists of a 6X4 rectifier tube, sizable filter capacitors, and an 0A2 voltage regulator tube to stabilize d.c. to the voltmeter circuit so that it is unaffected by line variations.

Statistics

The B&W Model 410 measures harmonic distortion of signals with a fundamental in the range 20 cps to 20,000 cps. It is accurate within 5 per cent of full scale deflection with residual frequencies up to 60,000 eps (0.05 per cent on the

lowest scale), and it is accurate within 15 per cent of full scale with residual frequencies between 60,000 and 100,000 cps. In comparison with other instruments known to be equally accurate, the B & W Model 410 gave precisely the same distortion readings. Input impedance for distortion measurements is 100k ohms shunted by 82 pf, and the input sensitivity is 0.1 to 30 volts rms.

The voltmeter is accurate within 5 per cent of full scale from 20 cps to 200,000 cps. We found that this VTVM compares exceedingly well with instruments of laboratory quality. Voltmeter sensitivity is 0.001 to 300 volts rms for full scale deflection. The input impedance is 1 megohm shunted by 27 pf in the 300-1 volt position, and 1 megohm shunted by 39 pf in the 300-1 mv position. The voltmeter residual noise is less than 0.02 mv. The output terminal voltage is 0.2 volts rms for full scale reading on any range position.

In sum, the B & W Model 410 is a high quality distortion meter, and an equally fine a.c. VTVM. It is definitely several cuts above the service instrument classification. Its price category is in the under $200 range. A good buy for its category. **Circle 161**

HEATHKIT MODEL IP-20 REGULATED POWER SUPPLY

Any experimental or developmental work with electronic gear has always required some source of voltage—usually d.c., and sometimes with a.c. being required in addition for heater supply with vacuum-tube circuits. When one begins to experiment with transistor circuits, d.c. is still required, generally at lower voltages and higher currents. With power amplifier circuits, storage batteries seem a logical source of d.c., but this type of battery has a very low internal resistance and in the event of a short, the current can increase tremendously. Attempted protection by means of fuses does little good because they are not fast enough—the transistor goes before the fuse does. Obviously, the answer lies in a current-limited, voltage-regulated power supply operating from the usual 117-volt a.c. line.

Such a device is the Heathkit IP-20 Transistorized Regulated Power Supply, shown in Fig. 4. This unit provides any voltage from 0.5 to 50 at any current from 0 to 1.5 amperes with a regulation of ±15 millivolts maximum (it can be adjusted for zero regulation at any selected voltage). In addition, it has an automatic current limiter to protect both the load and the power supply itself, together with an overload relay which opens in case of a direct short or overload. The circuit employs five transistors, nine diodes, one Zener diode, and a voltage-regulator tube for the reference

(*Continued on page 58*)

IITRI STORY

(*from page 28*)

to 3¾ ips or, hopefully, to 1⅞ ips. Most recorder manufacturers, prerecorded tape companies and raw tape producers are enthusiastic about the project because, even though it will mean that a hobbyist needs only a quarter or half as much tape to record a symphony, slow tape speeds will reduce the cost of recording to a point where the industry can compete successfully with records.

An offshoot of Camras' work on recording at slower tape speeds is the IITRI tape cartridge system, introduced in 1959, at approximately the same time as CBS Laboratories introduced the system which is being used by Minnesota Mining & Manufacturing. The IITRI cartridge can be changed automatically by a player changer. It can also be played on a conventional recorder because it uses standard quarter-inch recording tape. It can be recorded stereophonically in both directions (as reel-to-reel tape is) and can be recorded at any standard tape speed. Some IITRI staffers hold out for 3¾ ips as the optimum speed for the system, because it combines fidelity with a long playing time. Camras says that it could work just as well at 7½ ips with half the playing time, or at 1⅞ ips. "It's very economical for a tape duplicator to produce cartridges, even if there are no machines to play back automatically. Cartridges can be played on ordinary machines until the public owns enough of them to demand the introduction of an automatic player." He notes that at 3¾ ips, the cartridges could contain as much as 1½ hours of music. "This smaller size is much less wasteful than the big boxes tape comes in now. When I look at the small amount of tape that comes on some of those seven-inch reels, I'm shocked."

The Camras cartridge system contrasts with the Minnesota Mining cartridge player, introduced last year to the public. The latter uses wallet-sized cartridges which contain a maximum of 48 minutes of music and, because of the width of the tape they use, are not compatible with existing recorders. The 3M tapes are recorded in one direction only and must be rewound before the changing mechanism drops the next tape. The Camras cartridge can be recorded in both directions, as is a conventional prerecorded tape. This permits the inclusion of twice as much music in the same size cartridge and the reduction of the interruption between one cartridge and the next.

Is IITRI prepared to do battle with manufacturers over a cartridge player system? "We're not in the business of manufacturing or marketing magnetic recording products," Dr. Brophy explains. "We believe we have a pretty

good cartridge player system, and we're showing it to people who might like to manufacture and market it under license. I might say that some manufacturers have expressed interest in it." He said, too, that the manufacturers in question were waiting to see what would become of the other cartridge systems before making their own moves.

Home Video Recorder

Certainly one of the most interesting pieces of equipment on the premises at IITRI is Camras' working model of a home videotape recorder. "I'm actually working on several approaches," Camras says when discussing the subject of videotape. "The picture quality of cheap machines now is substandard. What I'm trying to do is to produce a machine which can produce a picture quality which will be acceptable in the home at a price acceptable to the general public." As a result, Camras actually has two types of recorders in mind: one which will operate at 120 ips using standard audio tape on a seven-inch reel; and one which will use half-inch tape at a speed of 7½ ips. The fast speed is being used by Cinerama-Telcan and Fairchild Camera Corporation, the first two companies to demonstrate low-cost home videotape recorders. The IITRI 120-ips machine will record an hour of picture and sound on a seven-inch reel of triple play tape by making ten passes across the tape. A reverse-o-matic feature reverses tape direction automatically at the end of each track with a brief interruption. Fairchild uses the same feature on its machine, which makes four passes on an 11-inch reel of triple play instrumentation tape and also yields an hour's recording time. The Telcan recorder gets 22 minutes on each of two tracks on an 11¼-in. reel of standard audio tape. The 7½-ips recorder uses a half-inch tape coated with an audio oxide formulation and produces a picture quality similar to 16-mm black and white movie film. "In the meantime, I'd expect to see several home recorders at a lower price offering low-quality videotape as an extra feature. The buyer would realize that the picture quality is poor, but he'd be getting the video feature, in effect, for free when he buys a conventional sound recorder."

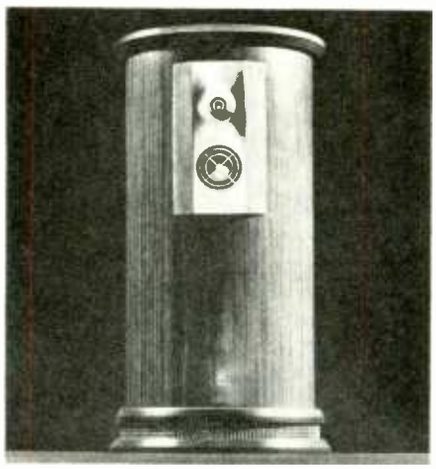
IITRI's work on a tape speech compressor may not be of immediate interest to home recordists, but it could have profound implications in broadcasting and business. "When a stenographer slows down or speeds up a tape now on which a letter has been dictated," Camras explains, "there is a consequent lowering or raising of the pitch of the voice. If you cut the speed in half, as you would playing back a tape recorded at 7½ ips, at 3¾ ips, for example, you hear it an octave lower than it was recorded. It's almost unrecognizeable. What the speech compressor will do is to allow you to slow down or speed up a recorded voice without any change in its pitch. A secretary would be able, by adjusting a knob, to play back a tape at any speed she chooses and still hear her boss speaking in his normal voice. This has applications in broadcasting. Suppose, for example, you have a recorded speech which runs 32 minutes and you've got only 30 minutes in which to broadcast it. You'll be able to play the whole tape—without editing, and without any unnatural sound in the voice—in the half hour."

The IITRI researcher said the compressor hasn't been fully developed, and declined to discuss details of the invention. But raw tape manufacturers already are rubbing their hands in glee at the prospect of wholesale conversions of offices to tape and recorders for dictation, which such an invention would cause.

What does the man who does the work in the back room of the tape industry see coming next in magnetic recording? With Camras' typical humor, he notes, "Looking back at periods just prior to the announcement of major advances in magnetic recording of the past, I notice that there are no definite foreshadowings of what would take hold next. Therefore my best advice is not to put too much faith in any predictions of mine. We will continue to expect the unexpected." Æ

NEW PRODUCTS

• **Column Speaker System.** The Empire Grenadier Model 8000 is a column-shaped speaker system with a divergent lens for the mid and high frequencies. Not only is it a handsome piece of furniture, but also, it permits placement in almost any convenient place in the room. Frequency range



is 30 to 20,000 cps, power handling capacity, music power, is 100 watts, and nominal impedance is 8 ohms. It contains a 12-in. woofer with 4-in. voice coil, a direct radiator mid range, and a dome tweeter. Its dimensions are 29" high, 15¼" in diameter and it weighs 65 lb. It is finished in satin walnut polyester. Price is $180. Empire Scientific. **Circle 196**

Stereo Tape Recorder. Concord Electronics has released the Concord Model 440 which allows up to 24 hours of recording time on a single 3600′ reel of tape, at a playing speed of 1⅞ ips. In addition the Concord 440 features pushbutton operation, transistorized preamps, three speeds, sound-with-sound, exclusive Concord Trans-A-Track, separate mixing inputs, automatic pressure roller disengage-

ment, two dynamic mikes, cue and edit button, and a digital tape counter. The 6" wide-range speakers are separated, with additional speaker outputs available. The Concord 440 is priced at $240. Concord Electronics Corp., 809 North Cahuenga Blvd., Los Angeles 38, Calif. **Circle 197**

• **Multiplex Tuner.** Kenwood Electronics, Inc. has introduced a new automatic stereo multiplex tuner, Model KW-500 featuring an exclusive FM-stereo indicator. The all-new KW-550 front panel design incorporates a red light which automatically changes to blue when receiving FM stereo stations. The new Kenwood model features

automatic relay switching to proper mode and automatically indicates FM-stereo multiplex or monophonic. The unit is priced at $169.95. Kenwood Electronics simultaneously announced a new high-power integrated stereo amplifier, Model KW-220, total 100 watts music power. Thirteen front-panel controls provide for every possible use. The KW-220 is also priced at $169.95. Kenwood Electronics, Inc., 3700 South Broadway Place, Los Angeles, California. 90007. **Circle 198**

• **Microphone Mixer Amplifier.** A new four-channel all-transistor microphone mixer-amplifier has been added to the Public Address equipment line by Bell Sound. Designated the Be-M4, the new mixer is designed to work with any existing PA amplifier or booster amplifier to extend the input capability of the system. The Be-M4 includes individual inputs and gain controls for four low-impedance microphones and an external phono unit. A VU meter is included as well as headphone jacks so program level may be monitored both aurally and visually. A new feature is a cueing facility on each microphone channel. Each microphone gain control can be

pulled into the "cue" position and the VU meter may be switched to that microphone position, permitting the operator to adjust microphone levels and preview the sound, prior to switching it to the program line. The Be-M4 has a response of 20 to 20,000 cps ±2 db and requires 5 watts of a.c. power for operation. Its size of 3" × 10" × 15" and styling are compatible with other Bell Be-series amplifiers. It weighs 9 pounds. Regular unbalanced 600-ohm output (or balanced 600-ohm output by using a plug-in output transformer) is provided. A special control output permits it to control standby power on a remote booster amplifier, if desired. TRW Columbus Division, 6325 Huntley Road, Columbus 24, Ohio. **Circle 199**

• **Speaker System.** The Newport, a two-way speaker system has been added to the line of three-way systems made by Sherwood Electronic Laboratories. Priced at $84.50, the system features a ten-inch woofer, a four-inch midtweeter, and an 1,800-cps crossover network. A high compliance device, the ten-inch woofer features a single roll suspension which provides a 23-cps free-air resonance for extended low-frequency response. In addition, the woofer voice coil has a four layer winding which boosts efficiency, and has a one-inch-long throw to minimize distortion. A special combination midrange and tweeter speaker, with a shallow-ring radiator, reproduces the mid-frequencies as well as the super-high frequencies. Overall response of the system is 53 cps to 17,000 cps ± 2½ db. The Newport handles 45-watts of program material. Minimum drive requirement is 10-watts. The speakers are mounted on a one-inch thick resin-filled flakeboard baffle. The enclosure itself is made of three-quarter-inch solid-core walnut veneered plywood. Size of the enclosure is 24 × 13 × 9½-inches deep. Called

the Model SR1, the Newport has a hand-rubbed walnut finish and cane grille. Either consolette legs or pedestal bases are available. The enclosure is also available in unfinished birch. Sherwood Electronic Laboratories, Inc., 4300 North California Ave., Chicago, Ill. **Circle 200**

• **Theatre Organ Kit.** A three-manual "Theatre" organ kit, the "Cinema," smallest and latest of the Artisan family, measures only 30" deep and 46" high, yet meets AGO specifications with three full 61-note manuals, a concave, 32-note clavier. Other features include intermanual couplers, twin expression pedals, independent vibratos, independent oscillators for every key of each keyboard, built-in music light

and pre-set combination pistons. The console style, modified for the home, is influenced by the romantic organ of the silent movie era and offers a stop list of authentic theatre voices. Chimes, orchestra bells, vibra harp and bandbox are optional. A variety of finishes and matching tone cabinets is available. Artisan Organs, 2476 N. Lake Ave., Altadena, California. **Circle 201**

• **Stereo VU Balance Meter.** Lafayette Radio Electronics Corporation introduces an audio output level indicator for maintaining proper balance of stereo systems. It is Model TM-45. Price, $7.95. Two precisely-damped loudness meters have continuously variable attenuators for up to

Get ready ...THE EXCITEMENT IS ABOUT TO BEGIN

Now she says . . . "Turn it up, please"

She gets pleasure from the sound of the McIntosh MA 230 control amplifier. She wants to hear all the full rich sound. She even thinks the loudspeakers sound bigger. Her bridge club wants to listen. Sometimes you wish she would let you listen to what you want to hear.

The McIntosh MA 230 control amplifier brings exciting performance to your present stereo system. The amplifier is the heart of your music system. All sound sources must go in and come out of the amplifier. Why deny her full enjoyment from your stereo system with an inadequate amplifier? Let her hear stereo through an MA 230. She will exclaim at the exciting difference she hears when using the McIntosh MA 230.

SPEAKERS SOUND BIGGER

Your speakers will sound bigger. Hum, noise and distortion from inadequate amplifiers color the musical content of the program material. Your speakers reproduce all of this. Distortion makes the music harsh and hard to listen to for long periods of time. Hum robs your loudspeakers of bass response. The McIntosh MA 230 has the lowest hum and noise of any control amplifier. Total hum and noise is 1/1,000,000 of the total power output. The MA 230 has less distortion than any other control amplifier with both channels operating. Distortion at a full thirty watts per channel is less than ½ of 1% from 20 cycles to 20,000 cycles per second. IHF music power rating is 44 watts per channel. *Power to spare!* No other control amplifier gives this kind of performance.

Your records will expand and have a transparent quality. The solid state preamplifier of the MA 230 has the best dynamic range of any control amplifier. Dynamic range makes music come alive. From the softest to the loudest passage the McIntosh MA 230 delivers all the program material. Each note, each passage comes alive.

'AMERICAN RECORD GUIDE' REPORTS ON THE MA 230

"McIntosh is an exception. It is one of the few firms in the industry that has a reputation for consistent understatement. Its eminence in the amplifier-preamplifier-tuner field is built on a secure foundation of performance—and on specifications written in the engineering, not the advertising, department."

"I did a lot of listening with this unit. It is powerful, and it is honest, in its presentation of music. I am bound to say that the MA 230 stands with the very best units I know of any design. I invested considerable time and effort in trying to disprove McIntosh advertised specs. I could not do so. I do not know another integrated amplifier with such superb power response."

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You get a full three year factory service contract on all parts and labor. Only tubes, fuses, and transportation are excepted.

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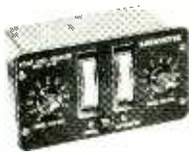
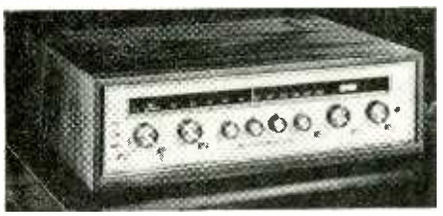
Circle 131 on Reader Service Card

20-db attenuation of each channel. A calibration switch permits exact matching. Scales are calibrated in VU and percent. Input impedance is greater than 8000 ohms per channel, and sensitivity 1.2 volts. The meters respond to speech or music waveforms and are ideal for stereo speaker



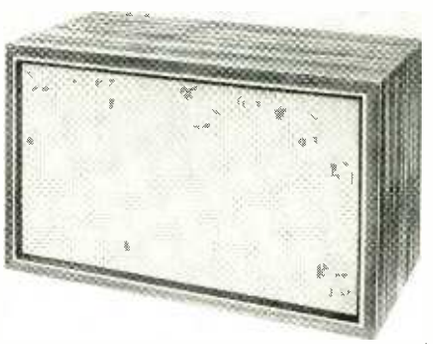
level matching or maintaining equal outputs from a stereo tuner. The entire unit is housed in a plastic case 6"W × 3¼"H × 2¾"D. Predrilled for panel mounting. Shpg. wt., 3 lbs. Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, N. Y. **Circle 205**

● **New Tuner-Amplifier.** A new 80-watt FM stereo tuner/amplifier with brushed silver-satin styling has been introduced by Sherwood Electronics Laboratories, Inc., Chicago. The new component, called the S-8000IV, features a powered center speaker



channel. The new, integral channel permits direct connection of a center or third-channel speaker system, or the addition of extension monophonic speakers in other rooms. No extraneous wiring or patching is needed and no external power source is required. In addition, the S-8000IV has a front-panel stereo headphone jack and a front-panel speaker disabling switch which gives the listener complete control over his listening options. The tuner-amplifier has a 1.8μv (IHF) sensitivity for receiving low-power FM stations. A 2.4-db capture effect eliminates stereo broadcast background noise and a special interchannel muting circuit suppresses between-station noise when tuning. FM distortion is only 0.3 per cent at 100 per cent modulation. Price of the new component is $329.50. A leatherette case is available at $9.50, and a genuine walnut cabinet is optional at $29.50. Sherwood Electronics Laboratories, Inc. 4300 N. California Ave., Chicago, Ill. 60618. **Circle 202**

● **Speaker System.** Lafayette Radio Electronics Corporation has added a new speaker system, the Decor-ette III, a three-way bookshelf speaker system. Called the SK-275, the system employs three custom-made British speakers. The speakers feature a newly-developed 12-inch woofer with a special foam-treated cone and a free-air resonance of 35 cps, a 6-inch mid-range unit with closed back to prevent interaction with the woofer, and a sealed cone-type tweeter. Using a sealed enclosure with a tuned-tube duct, the system achieves an over-all response from 30 to 30,600 cps. The crossover points are at 2,000 and 5,000 cps. Although maximum power rating is 25 watts continuous or 50 watts instantaneous peak, the system may be used with amplifiers rated as low as



10 watts. Impedance is nominal 8 ohms. Available in oiled walnut. May be placed either vertically or horizontally. The system measures 14" × 24" × 12" deep and weighs 30 lbs. Price: $79.95. Lafayette Radio Electronics Corporation, 111 Jericho Turnpike, Syosset, N. Y. **Circle 203**

● **"Foctball-Shaped" Speakers.** Roughly equivalent to corresponding oval speakers, the new "football-shaped" speakers use only two mounting studs instead of four. The 5 × 8" model, SP58D-8, has a 1.47 ounce Alnico V magnet; the 6 × 10" model, SP610E-8, has a 2.15 ounce Alnico V magnet. Both speakers employ 8-ohm

voice coils. The SP58D-8 has the same size cone and pad ring as a conventional 5 × 7" speaker, but the "basket" is one inch longer. The model SP610E-8 is similarly equivalent to a 6 × 9" speaker. Utah Electronics Corp., 1124 E. Franklin St., Huntington, Ind. **Circle 204**

AUDIOCLINIC

(*from page 4*)

Oscillation in Amplifiers

Q. My home-built amplifier worked fine until two months ago. The circuit is an ultra-linear Williamson, using 6SN7's as phase splitter and drivers. The output tubes are 807's feeding a Stancer output transformer. The trouble with the amplifier is oscillations from about 500 cps on down. The oscillations show up as riders on a sineware. All resistors and capacitors are within their rated tolerances. The capacitors are not shorted or leaking. In fact, the coupling capacitors are oil-filled units. The voltages are correct as specified on the schematic.

By open-circuiting the feedback loop, or reducing it to the point where there is almost no feedback, I can make the oscillations disappear. I tried changing the value of the phase-shifting capacitor across the feedback resistor. Increasing its value to about four times normal helped somewhat. As far as I can tell with an ohmmeter, the output transformer is all right.

I have a number of books on amplifier repair. I tried all the suggestions they had to make, to no avail. William A. Sasek, San Leandro, California.

A. I have a suspicion that the output transformer is defective, possibly suffering from a shorted turn somewhere along the line. A noticeable decrease in power output would support my theory. Severe oscillation can also reduce the power output of an amplifier, but your description does not seem to indicate that the oscillations are that severe.

Are you quite certain that the decoupling and filter capacitors are still holding their values? If not, oscillations can result.

A shorted turn in a power output transformer does not change the dc resistance of the winding to any great extent, therefore the ohmmeter test would not be conclusive.

The FM Band and TV Receivers

Q. In adjusting the strips of the turret tuner of my TV set, I have found that the Channel 6 strip can be tuned to certain FM stations though perhaps with more distortion than with an FM tuner.

If done properly, can one get good FM reception by this method? Can strips be altered so that they can cover the complete FM band (mine covered only a small part of it) or does anyone make such strips? Wm. J. Tally, Gadsden, Alabama.

A. You probably cannot obtain good FM reception by tuning the slugs of your TV tuner if the set you have is of modern design because the detector of this receiver is designed to accept a bandwidth narrower than that used in the FM band.

Some television receivers can be used in the manner you specify here because of their greater bandwidth. However, they are not of the intercarrier type and are usually old models. Two television receivers which can give adequate FM performance are the RCA 630 and the Dumont RE-101. In the case of the RCA, the tuner would have to be replaced with a turret tuner. The Dumont receiver has a tuner which covers the entire spectrum of TV channels, plus the FM band. However, this tuner does not have good sensitivity. It, too, might have to be replaced by a turret tuner.

I know of no strips which are made specifically to cover the FM band. However, the Channel 6 strip can be altered by removing some turns so that the frequency of oscillation will be raised, thereby allowing the strip to be tuned over the entire FM band. You will have to remove both rf and oscillator turns. If the coils are tapped, you will have to remove turns in such a way as to keep the tap at the same relative position on the coil. The rf must be made to resonate to the middle of the FM band.

If you are an experimenter, try this: Obtain an old RCA 630 chassis in working condition, insofar as sound is concerned, substitute a turret tuner for the original unit used in the set. This combination will provide good bandwidth and sensitivity to make your experiment worthwhile.

Be certain that you resonate the output of the tuner to the i.f. of the TV set. Be sure, initially, that the tuner you select is designed for output on 21 mc, the i.f. of the 630. If you have a tuner designed for a higher i.f., you can alter the tuner merely by replacing the output transformer with one which will tune to 21 mc. In this work and in the work of rewinding the Channel 6 slug you will find a grid dip oscillator to be an invaluable tool. Such an instrument enables the user to determine the frequency at which a tuned circuit is resonant.

I shall assume now that you are not planning to use this receiver to cover the television channels. What you should do is to fit the Channel 6 slug with a coupling which will enable you to adjust the oscillator frequency externally. The fine tuning control will not give you sufficient frequency change, and hence, the external fitting, directly connected to the slug.

Naturally, when this slug coupler has been fitted, it will be impossible to change channels. This is why I had to make the assumption that you would not use your receiver for television reception. If you do wish to use your receiver for viewing, then you will have to provide a means whereby the coupling can be easily removed and re-attached when necessary.

If you only wish to hear a few stations, you can obtain several Channel 6 strips and adjust each to receive a particular station. Insert these into the turret in the spaces where no local television channels are available. For example, if there is no channel 3 in your area, channel three can be removed and one of these altered slugs can be inserted and adjusted to receive a particular station. This can be done with as many channels as can be accommodated in the turret.

I am sure that there are other sets which can be used, but I have not experimented with them. Some of you may come upon such receivers. If you have some experience with such equipment, perhaps you would like to send them to me for inclusion in my other column, "Audio Techniques" which appears sporadically in these pages.

High Fidelity AM Reception

Q. In my area there are several AM radio stations broadcasting an FM format. I would like to listen to them, but there is one problem, however. These transmitters are low-power jobs, 500–1000 watts. They are sandwiched in between several 50 KW monsters.

I have tried several of the so-called high fidelity AM tuners with absolutely no success. They are noisy and nonselective for these low-power stations. I beat the "selectivity rap" with a home-brewed r. f. setup with individually tunable stages. It was not good enough for a decent signal-to-noise ratio.

I would appreciate your specific recommendation as to a broadcast band, AM only, superheterodyne unit that will give me reasonably good selectivity, sensitivity and the fidelity that I want. I can get the first two with a communications reciever but this type of circuit takes no pains with fidelity beyond that required for receiving voice frequencies. Besides, I would be paying for features that I do not need.

What would you say to a configuration using several stages of low-noise triodes in a t. r. f. circuit to obtain adequate r. f. gain, followed by a superheterodyne circuit? I realize the exhausting tuning involved but I am interested only in receiving two frequencies. Thomas F. Steiger, Mt. Prospect, Illinois.

A. If an AM tuner is to be reasonably close in sound to that of a good FM tuner, it cannot be selective. Selectivity will cut down on the reception of the entire sideband envelope. The parts of

this envelope which are rejected are the ones containing the high frequencies which you need badly. Poor selectivity will intensify atmospherics and will allow the heterodynes between broadcast stations to be heard clearly.

If I were constructing a receiver to be reasonably satisfactory, it would have to be a compromise between maximum fidelity and endurable background noise. I would use one or two r. f. stages. They would be pentodes. I realize that cascode amplifiers would have less noise, as you indicate, but the receiver noise is not the main kind of noise heard on the broadcast band. The most common type of noise is produced by atmospheric static and by noise which is transmitted along the a.c. supply line. Such noise will mask the noise produced in a pentode stage. Cascode r.f. stages find the widest acceptance and application in the VHF portion of the spectrum, where man-made and atmospheric noises are less apparent.

I would not separately tune each stage. If I were going to have two r.f. stages, a mixer and an oscillator, I would use a 4-gang tuning capacitor having the appropriate capacitance range. Naturally, I would try for maximum tracking but I would not be too concerned with a slight amount of mistracking because such mistracking will not degrade the selectivity of the receiver. The r.f. end of a superheterodyne receiver is used to provide gain and sufficient selectivity to prevent image responses. The selectivity of a superheterodyne receiver takes place in the i.f. amplifier. (There are certain exceptions to this, but they need not be discussed here.)

The signal from the mixer would, in my version of a high fidelity AM tuner, feed into two i.f. stages. Here we have two choices. The i.f. of this receiver could be set at 1750 kc or 455 kc. In the first instance, the i.f. transformers would be lined up for maximum selectivity. I would not be at all surprised to find that such an i.f. strip would be too broad for our purpose. The 455 kc strip seems more promising. However, the circuits would not be aligned for maximum selectivity, but would be stagger-tuned to permit a total bandwidth of 15 kc. Regardless of the i.f. chosen, I would add a filter which would limit the audio beyond 8.5 kc. This addition is necessary to eliminate the whistles produced by the beats of stations on the broadcast band.

Although you are not able to use a high fidelity AM tuner, I don't believe you should consider such tuners as poor or worthless devices. They will work very well in locations where the signals you wish to hear are strong enough to overcome some of the difficulties we have been discussing. I own such a tuner and it gives a good account of itself, helped immeasurably by a filter to remove all frequencies above 8.5 kc. Æ

RECORDS

(from page 41)

Here he is again, the big man at Salzburg in his day as Mozart was a century-odd later. Muffat, too. His name I had at least heard.

This Biber music is really lovely; he was undoubtedly a lot more than just an average composer. A series of beautifully played Baroque works for strings, some with organ, some with harpsichord accompaniment, rich in content, gentle in expression. (Part of this gentleness comes from the typical playing of the Viennese group—utterly different from much American "old music" performance.) As for Muffat, his big five-section "Tribute in Harmony" of 1682 tries rather beautifully to reconcile the rival stylings of the day, the French and Italian.

EQUIPMENT PROFILE

(from page 49)

voltage. Two 2N2147 transistors, connected in parallel, serve as the series regulator, controlled by an R265A and a 2N398A, the latter providing some positive feedback to improve regulation. Normally the circuit is adjusted for zero regulation at 15 volts output, which gives optimum performance over the entire voltage range. For specific requirements, the adjustment can be made for any desired voltage, so that regulation is zero for that specific output voltage.

The fifth transistor serves as the current limiter. Output voltage is selected in steps of five volts by means of a switch, and for intermediate values by a continuously-variable control. The panel meter serves to indicate both voltage and current—the particular function being selected by a slide switch while the full-scale range is set for optimum readability. Thus when the voltage switch is set at 10 volts, the meter has a full-scale range of 15 volts; if the switch is set for 40 volts, the full-scale range of the meter is 50 volts. The current-range switch similarly sets the desired range, with full-scale indications of 50, 150, and 500 ma, and 1.5 amps, while another continuously-variable control gives intermediate settings. Once the current and voltage are set to the desired values, they remain constant. A decrease in load resistance, such as a short circuit, will cause the breaker to operate, and current cannot flow again until the reset switch is operated.

The entire circuit is free from case ground, eliminating the possibility of shorting the supply by inadvertent touching of the unit with a chassis of the equipment being fed, which usually has a positive ground with transistor equipment. Three terminals are provided, positive supply, negative supply, and case ground. Line fuse and a pilot light are also on the front panel.

Applications

Aside from the obvious uses like powering experimental circuits involving transistors, when the maximum current can be set to a given value, with complete assurance that the safe current value can not be exceeded, the IP-20 can be used for many other purposes. We once had occasion to determine the voltage drop across a current limiting resistor in a series-heater string of a TV set in which the voltage of the picture-tube heater was unknown. The "cold" resistance of the resistor in question measured around 2500 ohms. By putting 50 volts across the resistor and watching the current increase slowly, then gradually reducing the voltage as the resistor heated to maintain the current at 300 ma (its rated value), it was found that the stable voltage across the resistor when hot was only 20 volts. With this information, the remainder of the circuit calculations could be made.

The a.c. ripple in the supply is less than 150 μv, making it perfectly suitable for low-level amplifiers. When the unit is furnishing a current of 1.5 amps at a given voltage and the circuit is opened, no "flick" of the voltmeter can be seen. Observing the output on a scope, a spike of about 0.02 volts can be observed which lasts for some 25 ms. Voltage and current regulation remain effective over the input voltage range from 90 to 135 volts.

For higher currents, two or more IP-20's can be connected in parallel with 0.1-ohm resistors in the "hot" line from each. It is then only necessary to adjust both output voltages to the same value. Similarly, two or more units can be connected in series for higher voltages—this time with the current-ranges set to the same value.

Construction

Not more than ten hours should be required to construct and make the final adjustments to this unit, and on completion it can become an extremely useful addition to the experimenter's stable of laboratory equipment **Circle 162**

GENERATORS

(*from page 23*)

terval, during which an open circuit (no output) would exist. Because of this third mode, an alternating design is not used. The a.c. generator of *Fig.* 3, and the d.c. generator to be described (*Fig.* 8), each have only two modes of operation.

A typical transfer characteristic scope pattern for a good amplifier to the signal of *Fig.* 4 is seen in *Fig.* 5. In this example the amplifier is driven into hard clipping by the larger wave, and any transient bounce is displayed on recovery as a vertical (up and down) motion (oscillation) of the small trace about the zero level. This produces a characteristic pattern which once seen, is easily recognized. In the case of an amplifier with poor damping or stability, the oscillation may take several seconds to die down.

At the beginning, it will be most convenient to test at the mid frequency where the characteristic is a straight line (no phase shift). Later, as the significance of the various patterns becomes clearer, the test can be done at any frequency. For an amplifier designed to feed a speaker, use resistive, open circuit, and reactive loads.[1] For a preamp, use a resistive load equal in value to the following grid resistor, which is in the region of 100k plus. The bounce patterns obtained should be fairly independent of frequency.

For further information work both above and below overload. To make slow, continuous changes in amplitude, "wiggle" the pot manually.

Possible very high frequency transient effects of similar type will normally be seen at the same time, as a different transfer characteristic non-linearity, in the form of an oscillation pocket or a damped oscillation riding on part of the trace, rather than as an oscillation which modulates the whole trace up and down. High-frequency effects should be checked for with open circuit and reactive loadings, as they are more likely to show up under these conditions. It should be noted that the Crowhurst techniques have proven quite effective in correcting such flaws.

Another useful test signal can be made up using the same apparatus as *Fig.* 2, but adding a network after the audio oscillator to convert the sine wave into a mainly unipolar function. A diode and resistor allow this change (*Fig.* 6A), producing a wave clipped on one side, as in *Fig.* 6B. This is fed through the same transient generator as before, and pulsed manually in the same way. To change the signal from positive to negative, as illustrated in 6B, reverse the diode leads.

The scope patterns will again show transient effects as a vertical bounce. The differences in waves, however, shows how well the device under test handles a complex unipolar transient signal, and in particular, if there is any major difference between the sine signal and the unipolar signal pulse response. The need for unipolar or assymmetrical transient testing has been pointed out by Crowhurst (*Audio Measurements,* pg. 114–116).

A third test signal consists of a d.c. generator pulse, *Fig.* 7, which is a completely unipolar step function transient, of duration chosen by the operator. The wave is rectangular, or square. *Figure* 8 shows the d.c.-generator schematic. The output level is controlled by the pot.

[1] A reactive load used for testing should approximate the load presented by a typical dynamic speaker. In *Loudspeakers,* pg. 79–81, Briggs has shown that at 45 cycles a quality 10-in. speaker on open baffle was "electrically equivalent to a 20-ohm resistor in series with a 79 μf capacitor," while when mounted in a 2 cu. ft. reflex, the same speaker was "equivalent to a 24-ohm resistor in series with a 33 mh inductor." From this data, taken on a foam suspension unit, we can see that the load on the amplifier can differ from a pure resistance by a considerable amount. These reactive components change with frequency, and can degrade both damping and stability of a feedback amplifier.

and polarity can be reversed by the toggle switch.

With the generator of *Fig.* 8, the transfer characteristic patterns were found difficult to interpret, giving no clear picture of small transient flaws. This generator was found useful, however, for the study of gross effects. Here the test signal is similar to Mr. Briggs' generator, and for best evaluation either a memory, photography, or long persistance scope is needed. On amplifiers it can serve as a final transient test, for use after the more sensitive a.c. generator method has allowed zeroing in on correct component values.

In using these generators, it is not desirable to try to attain any kind of speed, for to be truly informative at very low frequencies, the repetition rate of the transient must be long enough for the damped oscillation to die down completely before the next pulse is applied. This means that if the bounce lasts for say 2 seconds (a very bad case), the second pulse should not be started before this. In this way the equipment under test has a chance to return to a steady or quiescent state before being "hit" again.

More rapid repetition rates—preferably non-uniform, to avoid approximating a steady-state condition—can of course be used, but because the patterns are faster, interpretation becomes more difficult.

The above tests and generators have been used in the design and checking of numerous heavily fed-back (20 db) amplifiers, and preamplifiers, to evaluate low-frequency transient response. In each case considerable information was obtained about the stability, damping, and overload characteristics, and it was discovered that circuits approaching the ideal condition (no vertical bounce), gave excellent results.

In many cases it was found that the basic circuit under test could not be made to pulse well, even with the most careful adjustment of time constant values. These circuits were therefore aban-

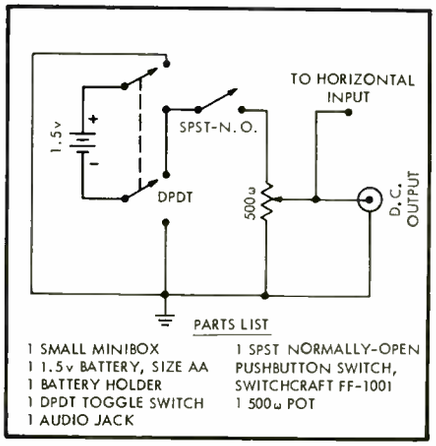


Fig. 8. Generator to produce the step waveform of Fig. 7.

doned, and others tried, until a better one was found.

A surprising case was that of a preamp of "fine" quality, which exhibited a more serious bounce at low levels than most of the power amplifiers at high levels.

With the techniques and devices described in this article, it is possible for the designer or builder to obtain a clear comparative picture of these defects, and to effect a "cure." In particular, the bass transient response can be readily observed and evaluated. Æ

ABOUT MUSIC

(*from page 14*)

revelation, Bean received only one critical letter; the writer complained, not about the results of the experiments, but about the fact that they had been conducted secretly.

The news of the experiments was made public on May 7th. From then until the end of the month, the system was used continuously. On the basis of the reactions of musicians, critics and the general public, the London County Council has decided to install the resonators permanently and to explore the possibility of extending the system to span the entire musical range.

Bean is understandably pleased with the outcome of the tests. "However," he remarked, with a jaunty smile, "I have a strain of skepticism, you know. I'll wait a couple of years for the *final* results." The Building Research Station is more sanguine about its achievement. It points to two technical advantages over other sound reinforcement systems: (1) "[each] loudspeaker has to reproduce only one frequency; i.e. not even only one note with all its harmonies, but only one frequency. Thus the biggest weakness of loudspeakers—their inability to reproduce the whole frequency range of music without some variation or distortion however slight—is overcome . . . (2) This system works in the auditorium proper; there is no question of using microphones to pick up orchestral sound directly, and thus there is no need for any 'balancing' of the musical sounds.

"If this new system works," the Building Research Station concludes, "the musician will be able to play a more active part in the acoustical conditions of the hall, at least as far as the reverberation is concerned, *because the reverberation need not be determined until the hall is finished.*" (italics mine)

The implications are obvious. Such an approach could revolutionize prevailing concepts of acoustical design. Unfortunately, I arrived in London too late to hear the "new sound" in the Royal Festival Hall. This will have to wait for next year. Æ

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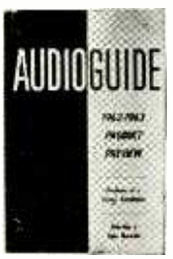
AUDIOGUIDE



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Harold D. Weiler

3rd Edition

The complete hi-fi story — answers all questions about tuners, changers, amplifiers, tape recorders, speakers, record players, etc. Lots of ideas for custom installations. Tells how to achieve concert hall reception in your home. 216 pages.

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Getting The Most Out Of Your Tape Recorder
Herman Burstein

Written in "plain talk" for the man who has, or wishes to buy, a tape recorder. It answers the myriad questions raised by tape recording enthusiasts. Its chapters cover every phase of operation and maintenance—from adding a tape recorder to the hi-fi system, to a thorough dissertation on microphones. Lots of practical information on how to buy. 176 pages.

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NOTE ON CURVE PLOTTING

(*from page 24*)

was the case with the particular standard. What is called for is a curve conforming with the admittance of a series combination of a capacitance and a resistance having a certain time constant. Since the desired curve is one expressed in decibels, one has to consider not pure admittances, but ratios of admittances, as follows:

Circuit "A" of *Fig.* 1 shows a series R-C circuit whose absolute value of impedance is given by:

$$Z = R\left[1 + \left(\frac{1}{\omega CR}\right)^2\right]^{\frac{1}{2}} \quad Eq.\ (1)$$

The time constant, T, of the discharge of a capacitor through a resistor is defined as the time required for the voltage or current to decay to $1/e = 0.3679$ of its value. For the charge of a capacitor, the same definition applies, the voltage "decaying" toward its steady-state value. The time constant of discharge or charge of the current in an inductor through a resistor follows a similar definition. Without going through the oft-published computations for these circuits, we may write

$$T = CR = \frac{L}{R} \qquad Eq.\ (2)$$

Substituting *Eq.* (2) in (1) we obtain

$$Z = R\left[1 + \left(\frac{1}{\omega T}\right)^2\right]^{\frac{1}{2}}$$

To plot the impedance variation with frequency in decibel fashion, we must know the impedance at a frequency when the reactive element has a negligible effect, that is, when the resistance is the controlling element. This we may do by writing

$$\text{db} = 20 \text{ lag } \frac{Z}{R} = 10 \log \left[1 + \left(\frac{1}{\omega T}\right)^2\right]$$

The equation for the admittance response, expressed in db, is the same as the equation above, except for a minus sign, because the admittance is the reciprocal of the impedance.

What remains to be done is to plot the curve for the time constant $T = 0.00318$ seconds as given by

$$\text{db} = -10 \log \left[1 + \left(\frac{1}{2\pi f \times 0.00318}\right)^2\right]$$

We may similarly plot the admittance response for a parallel combination of a capacitance and a resistance having a time constant of 50 microseconds to achieve the desired high-frequency response. The values can be obtained directly from the curves of *Fig.* 1 and introduced in the field of *Fig.* 2. The solid line of *Fig.* 2 represents the modification of the 6-db-per-octave curve in accordance with the prescribed test for the magnetic playback characteristics of ¼ in. tape travelling at 7½ inches per second.

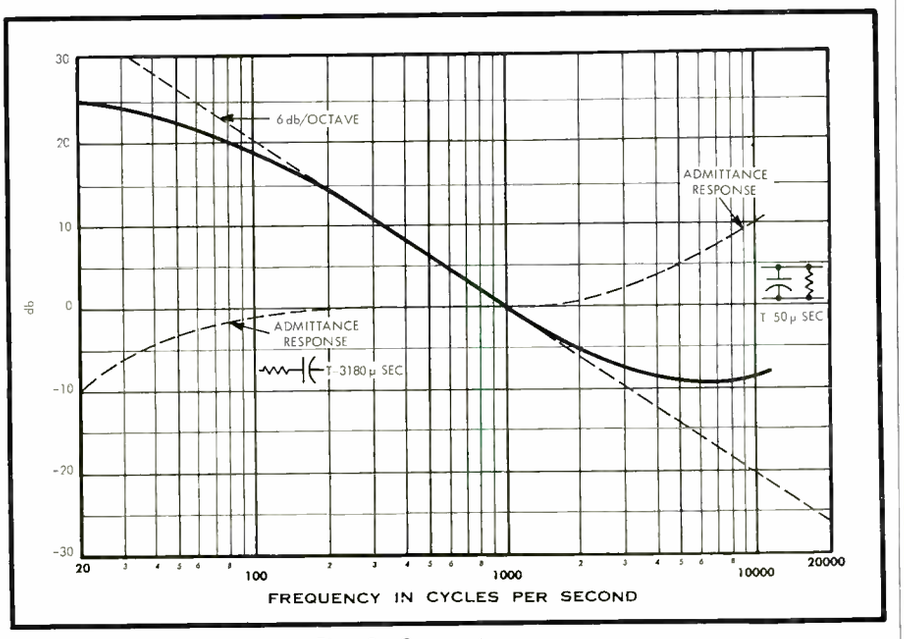

Fig. 2. Composite curve.

NEW LITERATURE

● **Tape Recorder Booklet.** Literature on the new Freeman Model 800 stereo tape recorder, priced at $299.50, is now available from the company. Specifications, features and photos of the three-speed Model 800, which records up to 24 hours of background music on a single seven-inch reel, are fully detailed in the literature offered, on request, by Freeman Electronics Corporation, 729 N. Highland Avenue, Los Angeles 38, California. **Circle 208**

● **Enlarged Condensed Semiconductor Catalog.** Amperex Electronic Corp. has announced the publication of their new condensed semiconductor catalog. Much expanded over previous editions, the new catalog is now 48 pages and contains much new material in addition to all the basic specifications of the full line of Amperex transistors, diodes and photosensitive devices. New chapters include: How to choose a photo-sensitive device; parameter conversion tables; circuits utilizing Amperex semi-conductors (i.e. chopper, differential amplifier, AM-FM receiver, sonobuoy transmitter); a full list of available Amperex application reports; outlines with measurements of all semiconductor envelopes used by Amperex; and on the back cover, a listing of Amperex sales representatives. Free copies of the condensed Amperex Semiconductor Catalog may be obtained by writing to Amperex on Company letterhead. Amperex Electronic Corp., Advertising Department, Hicksville, Long Island, New York 11802. **Circle 209**

● **New Brochure Contains Sample.** A unique brochure is now offered by Shakeproof, Division Illinois Tool Works Inc., on the company's line of TEKS self-drilling fasteners. The ingenuous thing about Shakeproof's new brochure is that it contains actual TEKS testing samples. Complete instructions are contained in the brochure detailing the method of application, equipment required, and drill speeds so that the samples can be removed and driven. TEKS-by-Shakeproof are said to do three jobs at once. They drill their own holes, tap, and fasten in one assembly-line operation. TEKS look like a screw, drill like a drill and reduce assembly costs, Shakeproof claims. For a copy of Shakeproof's TEKS sample-containing brochure, write: Shakeproof, Division Illinois Tool Works Inc., St. Charles Road, Elgin, Illinois 60120. **Circle 209**

● **Xcelite Product Bulletin.** An illustrated product bulletin from Xcelite Incorporated contains description, photo and price information on new Electronic Snips for cutting fine wire and filaments and stripping insulation in electronic assembly and service work. The snips are described as also being useful to hobbyists, electricians and jewelers for cutting not only wire but sheet metal and other light materials up to 0.025" thick. Bulletin N464 on the No. 86 Electronic Snips may be obtained by writing Xcelite Incorporated, Orchard Park, N. Y. **Circle 210**

● **Tape Recorder Brochure.** Newcomb Audio Products has produced a two-color brochure describing its TX10 Series stereophonic tape recorder. Newcomb Audio Products Co., Hollywood, Calif. 90038. **Circle 211**

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RCA 25 watt amplifier, MI-12298 (modified): 7 inputs; 4 mixers; 3 microphone preamplifiers with transformers; tone control; cage. Electrolytics, much wiring brand-new. Less 10 tubes. Cost $300, asking $100. Jay Rose, 7 Southgate, Great Neck, N. Y.

SELL: Jensen P15-LF Flexair woofer front mounted in 6 cubic foot walnut enclosure. Very handsome and extremely rigidly constructed, suitable for any quality high frequency unit. $70. Francis Daniel, 207 W. 106 Street, New York 25, N. Y.

KITS ASSEMBLED. Wendell Brase, Lake Mills, Iowa. Write for quotations.

CORRECTIONS TO AUGUST LISTINGS

The following cross references were not included in the manufacturers and importers listing in the Product Preview Section of the August issue.

ADC (see Audio Dynamics Corp.)
EMT (see Gotham Audio Corp.)
Finco (see Finney Co.)
JBL (see James B. Lansing, Inc.)
LTV University (see University Loudspeakers)
3M (see 3M Company)
Norelco (see North American Philips Co.)
Omega (see Stanford International)
PML (see Ercona Corp.)
Radford (see Lectronics of City Line Center)
Schoeps (see International Electroacoustics)
Stentorian (see Barker Sales)
Soundcraft (see Reeves Soundcraft Corp.)
Transwave (see Transistor Sound Laboratory, Inc.)
Uher (see Martel Electronic Corp.)
Weathers (see Telepro Industries)
Cecil E. Watts (see Elpa Marketing)
Wollensak (see 3M Company)

No addresses were given for 3M Company and Superex. They should be:

3M Company
Magnetic Products Division
Bloomfield Hills, Mich.

Superex Stereo/phones
Radford Place
Yonkers, N. Y.

Do not address inquiries about YL to the address in Japan. Instead send them to:

Provo High Fidelity
P. O. Box 204
Batavia, N. Y.

Langevin was described erroneously as an affiliate of Altec Lansing. Its correct name and address are:

Langevin, A Division of Sonotec, Inc.
503 South Grand Avenue
Santa Ana, Calif.

REK-O-KUT was credited with making a kit, Model R-34H at $69.95. It should have been K-34H at $59.95.

Industry Notes . . .

Raymond Pepe Dies

As we go to press, we learned the sad news that Raymond V. Pepe died of a heart attack in Los Angeles on August 15, 1964. Ray was Chairman of the Board of Directors of the Institute of High Fidelity and a past President. He was also Vice President of James B. Lansing Sound, Inc. He is survived by his wife and infant child.

• **Janszen Joins Acoustech.** Morley D. Kahn, President of Acoustech, Inc., announced that Arthur A. Janszen has joined the firm as Vice President and Director. Janszen has been consultant to Arthur D. Little, and held positions as Special Research Associate at the Harvard Underwater Sound Laboratory, Associate Professor of Engineering Research at Pennsylvania State College, Senior Research Assistant at the Harvard Acoustics Research Laboratory, President and General Manager of Janszen Laboratory, Inc., and Vice President and Director of KLH Research and Development Corp.

• **Koss New Rek-O-Kut President.—Will Move Plant.** Reflecting changes of a new controlling shareholder, Rek-O-Kut Co. Inc., pioneer manufacturer of high fidelity turntables announced major new operations plans at a stockholder meeting. Stockholders elected John C. Koss as new president and board Chairman. Koss, Milwaukee manufacturer of Koss Stereophones, recently purchased controlling interest in Rek-O-Kut from George Silber, former chief executive. The company had been operating under Chapter XI of the Federal Bankruptcy Act since May, 1963. Koss has settled the outstanding liabilities with creditors and told stockholders he is now preparing application for removal from Chapter XI status. Koss also announced that steps would be taken immediately to move the manufacture of Rek-O-Kut products to his Milwaukee plant. "I see no question," he said, "that manufacturing, administrative and marketing economics can be effected by fabricating the line in Milwaukee. This will mean a measure of financial relief in addition to the boost we expect from sales increases." Koss indicated that his production executives were currently studying the problems of a 900 mile corporate move and that it appeared all facets of operation would be in the midwest by November 1.

COVER INSTALLATION

This handsome wall unit graces the home of Paul A. Wassman of Hyattsville, Maryland. The wood work was done by the Wood Shop, Silver Spring, Maryland. It is all walnut and shelving can be placed in any desired location.

Components are as follows, starting top left and working to the right, EICO RP-100 and Bell T347 tape decks, Citation IV preamp, H. H. Scott 350 FM tuner. Hidden behind sliding door at lower right is a Citation V power amplifier. The speakers are Electro-Voice EV 6's.

Audio Controls Division
Altec Lansing Corporation

SUPERIOR NEW INSTRUMENT SWITCHES AND ATTENUATORS

It's no longer a secret that our Audio Controls Division at Altec is well on the way to producing what we feel will be the best instrument switches and attenuators ever made specifically for the recording and broadcast industries. Without wishing to detract from my own three decades as a design engineer and manufacturer in this field, nor from the superb facilities available to me at Altec, I must admit that much of the credit goes to the fact that we are starting from scratch on all of our designs. Frankly, this is an engineer's dream—no preconceived ideas, no old designs that have to be adapted, no existing tooling that has to be used. Our only concern is the here and now, and how can we make it better.

LOW NOISE, LOW MAINTENANCE, LONG LIFE

Looks like our switches and attenuators will give you the best set of performance specifications ever available. Here are a few of the things we've done to achieve this superiority: Each brush blade is independently sprung to provide contact all the time. We predict a total absence of contact bounce. The brush springs are completely out of the circuit and will carry no current. Our brushes are made of fine silver ("coin" silver, normally used, contains copper and is subject to oxidation which reduces conductivity and raises noise level among other things). The fine silver does not oxidize—it sulfides. This has two advantages: conductivity is not affected and sulphide of silver has a lubricative quality which is actually beneficial.

MORE INNOVATIONS

As you know, most switches come in round cans. We're putting ours in square ones. You don't have any use for the space around the can anyway so we're using the corners for the wiring. The result is that our switches will give you more positions in less space. For example, most switches have 12 positions at the most. Ours have 31 positions on a 1½" switch and up to 45 positions on the 2¼" one.

To cap the whole thing off, we'll be able to gang up to 8 of our attenuators in tandem so you can operate the whole works with just one control.

NEW SOLID STATE 470A PREAMP NEARLY READY

We announced this device in our last "Studio Talk." It's the one you can use as a preamp or as a line, booster, or program amp with no internal changes needed. By the way, the 470A has a lower noise level than any vacuum tube unit on the market.

And by the time you read this, our 61A Program Equalizer and 62A Graphic Equalizer will be in full production. So give me a call or drop me a line. I'll be happy to send you the latest information on what's here now and what's coming soon.

Art Davis

Audio Controls Division • Altec Lansing Corporation • Anaheim, California

Circle 148

ADVERTISING INDEX

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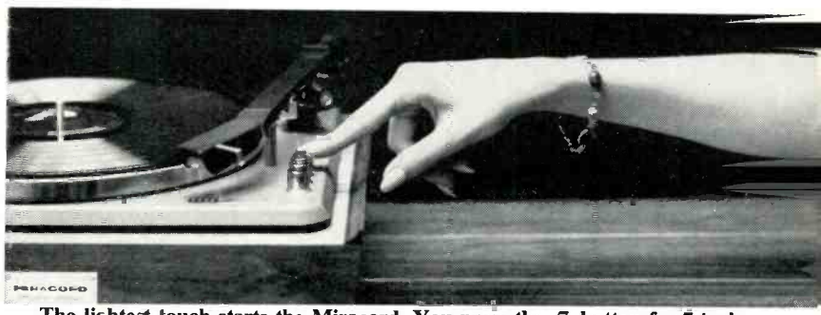
More gentle than people

These are the famous *feathertouch* push buttons which program the automatic functions of the Miracord.



The lightest touch starts the Miracord. You press the *7* button for 7-inch records, the *10* for 10-inch records, or the *12* for 12-inch records.

With the *short* spindle in position, the Miracord plays single records automatically. At the end of play, the arm automatically returns to its rest, and the unit shuts off. A light touch to the *stop* button does it sooner.

With the *short* spindle reversed, the Miracord repeats the same record continuously, until you remove the arm manually, or press the *stop* button.

With the *long* spindle inserted, you can play up to ten records in sequence. As each ends, the next one starts. Or you can press the button again to *reject* a record at any time, and bring the next record into play position.

However, you don't have to use the push buttons if you don't want to. You can also use the Miracord to play single records manually. It's all up to you. But, once you have the feel of the push buttons, you will never touch the arm again.

They're gentler than people.

BENJAMIN MIRACORD

Try it at your hi-fi dealer, or write:
Benjamin Electronic Sound Corp.
80 Swalm Street, Westbury, New York
Sole U.S distributor for Miracord turntables, Elac cartridges and other Electroacustic® audio components.

Circle 101 on Reader Service Card

HIFI/Stereo Review

June, 1964

"...the designers of the E-V TWO were aiming for a smooth, uncolored sound, and they have succeeded very well. Overall the E-V TWO is a very smooth and musical reproducer."

Radio-Electronics

February, 1964

"In brief, the E-V TWO's produce a quite spectacular sound with a big, low-down bass...that is the best, to my ears, that Electro-Voice has yet produced."

POPULAR SCIENCE

June, 1964

"They effortlessly fill my large listening room with clean, well-balanced sound."

AUDIO

April, 1964

"...the Electro-Voice Model SIX is as close in sound to a Patrician as one can come without being a Patrician. You listen."

high fidelity

April, 1964

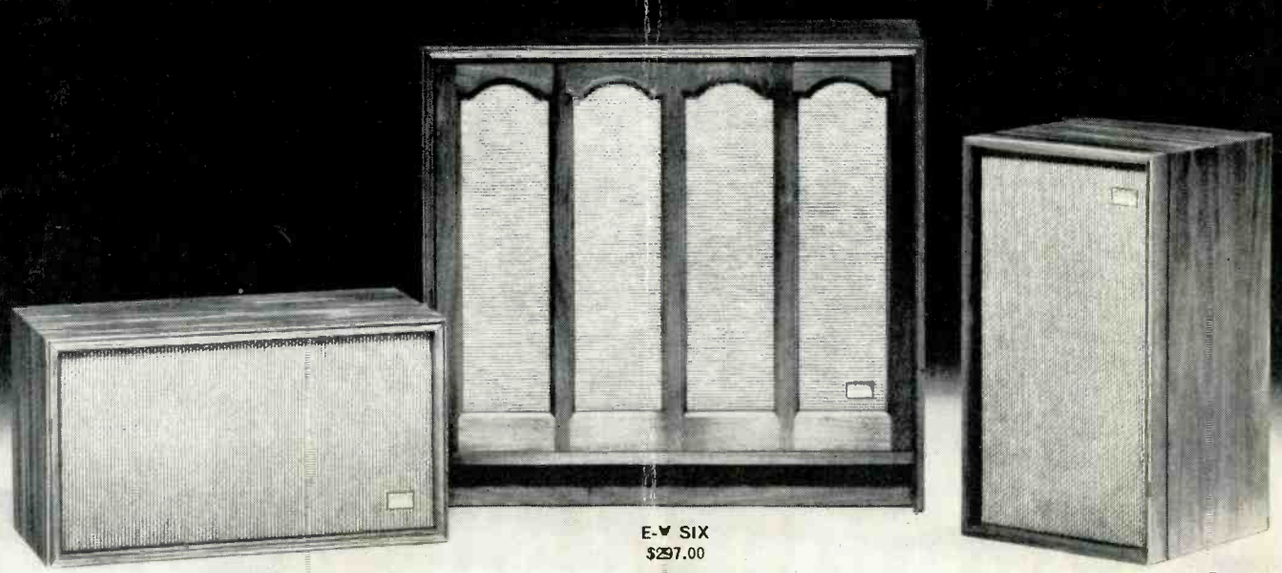
"Reproducing test tones, the Model SIX was found to have a remarkably smooth, clean and uniform response across the audio range!... But whatever one's personal listening tastes are, it would seem there is an E-V model to suit them."

The American Record Guide

December, 1963

"(I) have found them to be smooth and easy-to-listen-to...I found the top end very smooth and silky, not overbright, and also it extended well beyond the 15-kc. claim of the manufacturer."

If Speakers Could Blush, Ours Would!



E-V TWO
$120.00

E-V SIX
$297.00

E-V FOUR
$151.87

Read what the critics say about the new E-V TWO, E-V FOUR and E-V SIX acoustic suspension speaker systems. Then conduct your own impartial listening test. For a complete set of review reprints, plus the name of your nearest franchised E-V hi-fi showroom, write us today.

ELECTRO-VOICE, INC., Dept. 944A, Buchanan, Michigan 49107

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Electro-Voice®
SETTING NEW STANDARDS IN SOUND