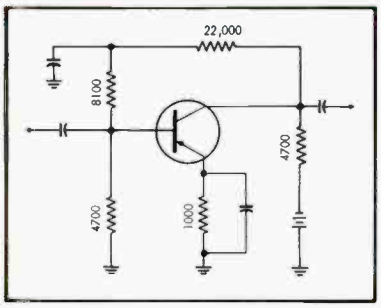
AUDIO

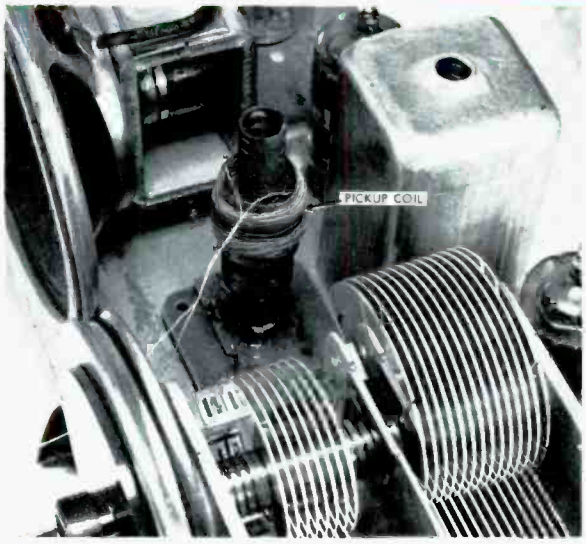
ENGINEERING MUSIC SOUND REPRODUCTION

JULY, 1956

50¢



Concluding Mr. Penfield's valuable discussion of transistors and the unique circuit requirements which must be followed to ensure stability. See page 20.



An inexpensive a.c./d.c. AM radio set can be converted into a "tuner" of good quality to feed a home music system by the use of a single transistor and a few resistors and capacitors. See page 15.

Effect of ROOM ENVIRONMENT on sound reproduction

TRANSISTORIZED AM TUNER CONVERSION

INPUT TRANSFORMER DESIGN—Part 2

TRANSISTOR BIAS STABILIZATION—Conclusion

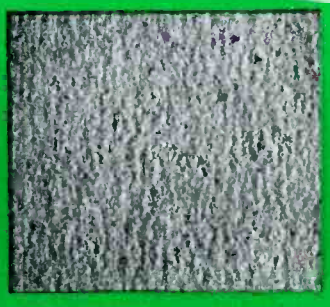
TAKE A GOOD LOOK

YOU CAN ACTUALLY SEE THE DIFFERENCE!

These are unretouched photomicrographs (not artist's conceptions) of FERRO-SHEEN tape and ordinary tape taken under identical conditions. Magnification is 50X. See how irregular the eggshell surface of the ordinary tape appears in comparison with the smooth FERRO-SHEEN tape. See how much smaller are the shadows and highlights of the FERRO-SHEEN tape. This indicates a much greater uniformity of oxide coating and an unparalleled super-smooth surface.

irish BRAND **FERRO-SHEEN HAS THE** *Smoothest Surface* **OF ALL RECORDING TAPES!**

FERRO-SHEEN TAPE



ORDINARY TAPE

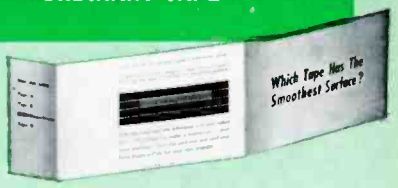
What Does This Super-Smoothness Mean to YOU?...

1 GREATLY REDUCED HEAD WEAR:
the mirror-smooth FERRO-SHEEN surface virtually eliminates disastrous headwear caused by the abrasive surface of ordinary tapes.

2 NO SHEDDING OF OXIDE:
unlike ordinary tapes which shed oxide particles that gum up the heads, the FERRO-SHEEN process anchors the oxide to the base so that it cannot come off and deposit itself on the head.

3 FLATTER FREQUENCY RESPONSE:
the super-smooth surface of FERRO-SHEEN tape makes better contact with the recording head, resulting in higher output, a very flat frequency response.

4 REDUCED "PRINT-THROUGH":
"Print-through" is virtually eliminated, even at excessive input levels, because of unparalleled oxide uniformity in FERRO-SHEEN process tape.



MAKE YOUR OWN TEST IN TWENTY SECONDS!...

Send for free Comparator Card which has strips of all of the leading tapes mounted side by side for your direct visual comparison. You will SEE the obvious difference at a glance. You will instantly recognize that irish FERRO-SHEEN process tape with its obvious smoother surface is the finest tape your recorder can use!

FERRO-SHEEN IS NOW AVAILABLE IN THESE QUALITY irish TAPES:

SHAMROCK #300: The ultimate in premium, professional tape for broadcast and studio use. 1.5 mil plastic base. Comes with 5' Mylar leader in dust-proof polyethylene bag.

LONG PLAY #600: Extends playing time 50% over conventional tapes of same size reel, on Dupont's miracle film Mylar.

DOUBLE-PLAY #7-2400: Now 2400' on a standard 7" reel. Twice as much playing time on all speeds. Mylar base.

If not available at your local dealer, write:

ORRADIO INDUSTRIES, INC., Opelika, Alabama

World's Largest Exclusive Magnetic Tape Manufacturer

EXPORT DIVISION: Morhan Exporting Corp., N. Y. C.
IN CANADA: Atlas RADIO CORP., Ltd., Toronto, Ontario

THE BRITISH INDUSTRIES

Sounding Board

Now

5 Garrard Record Players each the world's finest

Why?

The reason is simply that people's needs in record playing equipment vary considerably. Even assuming that all models of a line are made with the same eye to superlative quality, there are still differences in budget, variations in the physical setup of a music system, the user's own attitude toward features vs. price, and his personal ability to hear and appreciate the subtle variations in performance brought out by different record-playing units.
Therefore, Garrard now makes the following 5 models, intended to satisfy the requirements of every high fidelity system.

Model 301 . . .
"The Professional"
Transcription Turntable:

This is the turntable used by Mr. G. A. Briggs, at Carnegie Hall last October. Readers of Audio Magazine will recall that stock models of this $89.00 turntahle, recently tested by an independent laboratory (Audio Instrument Co., Inc.), under the personal direction of Mr. C. J. LeBel, performed even better than most professional disc-recording turntables. Mr. LeBel's full report was given in this magazine (May issue), and we will gladly send you a copy of the report. However, Mr. LeBel is not the only expert who has checked the Model 301 and found it outstanding. Garrard puts this turntable through the most exhaustive performance test procedure ever devised by a phonograph manufacturer . . . and accurate measurements of speed, wow, flutter, rumble, flash and insulation are contained in an individual inspection card, enclosed with each machine, and *referring to that turntable only*. We know of no other turntable which is so supported by documentary evidence of its fineness.

RC98 . . . "Crown II"
Super Auto-Manual
Record Changer:

New ideas come and go, but basic engineering advancements have a tendency to long life. This $67.50 unit is our highest priced record changer, yet it retains some of the basic features which Garrard pioneered as long as 20 years ago and which have never been surpassed. These include the pusher platform — bent spindle combination, still the only device insuring gentle handling of all records. In addition, the RC98 provides a veritable galaxy of innovations. An exclusive feature . . . rheostat-controlled continuously variable + or — wide range adjustment of each speed, "tunes" the changer to the pitch or key of a musical instrument. If you have "perfect pitch," you may be able to perceive even the slightest variations in the music, and you need

The Sounding Board

this special RC98 feature to keep all your records true to the original performance. Another important RC98 feature (now found on all Garrard changers) is a full-manual position which gives this automatic changer the added versatility of a first-line single-play manual turntable.

RC88 . . . "Triumph II" Deluxe Auto-Manual Record Changer:

Most high fidelity enthusiasts regard our previous "Triumph" model, the RC80, as the dean of high fidelity record changers. This machine set the standard of the field for six years. Now the RC80 has been superseded by the new RC88, which nets for $54.50. You can incorporate the RC88 into your system, knowing that it offers you features tested in thousands of homes and literally millions of playing hours. Besides the pusher platform, the RC88 has the all-Garrard-built Induction Surge 4-pole shaded motor — smoothest, quietest, most powerful and up-to-date type available today. This motor will cause no hum, even when used with sensitive pickups. It will run tirelessly and effortlessly year after year. And — the main operating part of the motor, the rotor, is super-finished and individually weighted by exclusive Garrard equipment . . . for quiet, perfect speed. The RC88, RC98 and RC121, are driven by a new-type true-turret drive with all speeds operating directly off the motor on a single turret. This provides excellent results, without belts.

RC121 . . . "Renown" Auto-Manual Mixer Changer:

This fine unit is the first Garrard Record Changer to be made with the straight spindle — overarm arrangement of the style you will find in many record changers. But here any resemblance to ordinary units stops. The RC121 is a mighty little machine and a true-Garrard changer. It is the most compact, most economical automatic changer ever presented by Garrard. It nets for $42.50 and fits into any cabinet area suitable for a record changer. This makes it your ideal replacement unit for old-fashioned changers of other makes which fit into smaller areas than could accommodate previous Garrard models. At the same time, despite its compact size, the RC121 offers almost every important Garrard feature, and some of its own. It has the same full manual position, the same type of motor, the same aluminum, true-tangent tone arm, heavy steel unit plate, and inch-high turntable. It comes fully wired, ready to plug in and play. A special feature . . . Simpli-Mix Operation, permits the RC121 to operate automatically on records of varying diameters, which may be stacked together.

Model T "Crest" Manual Record Player:

If yours is a budget system, and you do not need record changing features, the Model T will give you all the performance of the famed RC80 record changer, at the very low net price of $32.50. It is basically an RC80, with the record-changing mechanism left off. If you have been checking the budget system recommendations of experts during the past few years, you will have noticed how many times this unit has been endorsed.

We cannot go into greater detail here on the relative merits of the various Garrard units. However, we do have a special series of Product Analysis Sheets, covering each Garrard player. Request these sheets for your own comparison. The coupon below will bring them to you, with a copy of the B.I.C. High Fidelity Plan Book, which illustrates all Garrard and other Quality-Endorsed products of the B.I.C. Group.

Sincerely yours,

Leonard Carduner

President

British Industries Corporation Dept. GF-16
Port Washington, N. Y.

Please send BIC Hi Fi Plan Book, and the following Garrard Product Analysis Sheets:

☐ 301
☐ RC98
☐ RC88
☐ RC121
☐ Model "T"

Name_____

Address_____

City_____ State_____

JULY, 1956 VOL. 40, No. 7
Successor to RADIO. Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

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RADIO MAGAZINES, INC., P. O. Box 629, MINEOLA, N. Y.

JAZZ By...JEAN

JEAN SHEPHERD*

THE RED BALL is up for skating. The ramparts have been manned and the sound and fury of battle is still ringing in our ears; but the blood has ceased to flow. True, there are still occasional skirmishes in the undergrowth, but they represent only mopping-up actions. The veterans of the fight, those who have survived, are recovering from their wounds and are beginning to emerge above ground again. They have fought courageously and well and the time has now come for an accounting.

No longer does the jazz fan have to carry on his love affair with the music-that-moves-him under the cover of many subterfuges. He can bring his worn Coleman Hawkins discs right out into the open now and can even put them on his shelves for all to see. Some of them have even become so brazen as to play them with Other People present and have emerged not only unscathed but covered with glory and have been hailed for having hidden wellsprings of erudition. But now that jazz has become a parlor sport with intellectuals and duds alike, the thing is beginning to take on some of the more lurid aspects of both Madison Avenue and a one-night carnival. Not only has jazz become accepted in many erstwhile closed circles, it has all the earmarks of an incipient intellectual fad. Perhaps not even incipient. Jazz artists are turning a nice buck and everybody deems it a fine thing that all has turned out so well in the end. Almost like an MGM musical with Rock Hudson playing Bix Beiderbecke marrying Doris Day in the last reel. And about as true. Not that Bix wouldn't have minded making a fast buck or even minded Doris for that matter, but I for the life of me can't see Bix endorsing lipsticks or running a clip joint in the Village complete with "jazz musicians" equipped with press agents and a prop whiskey bottle on the piano.

I would love to see Jack Teagarden being interviewed by the assistant art and music editor, fresh out of Bennington, of a slick fashion mag that has just discovered "jazz." I can just hear her asking "Jack, can you tell Our Readers just what jazz is and how Paul Whiteman came to invent it?" "Well, Pops, it seemed one night in Chicago. . . ." Or for that matter, it would be a terrific ball to catch a group of Westchester matrons, avid readers of Places to Go in the *New Yorker*, sitting in the gloom of Basin Street "digging" the Mulligan Quintet. All of these vignettes might seem to be spun out of my own whole cheap cloth but such, happily, is not the case. These riotous scenes are being enacted almost every day now. Better than a W. C. Fields two reeler. Too bad someone isn't preserving a few of them for future generations. I've always said the real flavor of any time is largely lost to those who follow because the ingredients of the flavor are never put down. Only the results of the flavor are kept. But I digress. There have been some pretty fascinating things happening lately around the peripheries of jazz and it would take a tremendous amount of paper space to record them.

For example, most of the slick magazines ranging from *Time* to *The Saturday Evening Post* either have done full treatments on one or another phase of jazz or have things in the works. Jazz has become saleable not only on record but on the printed page and all other media, including the films. TV is lagging but you can be sure not for long. This sudden burst of public interest has brought along with the good much that is bad for both the legit jazz musician and the innocent public. A swarm of press agents and chic writers have descended into the arena and are industriously (and lucratively) feeding the sudden hunger for jazz information. Some of the results are hilarious in the extreme. Jazz is now being packaged and sold about as a breakfast cereal would be handled. The only difficulty is that press agents aren't critics and will shout just as loud for second-rate talent as for first. In the end, it seems as though the musician or agency that can afford the top pressmen will drag down the big bookings these days. And being able to afford something isn't always a criterion of ability. Not that a lot of good men aren't being heard from these days. They are. But many a second rater has had a full magazine treatment for the benefit of 10,000,000 readers while really top talent goes unsung by the same journalists. I have no panacea for this situation. I can only point out that it exists and then go out and do a few push-ups to relieve back ache.

Speaking of jazz writers and writings, I can't too highly recommend dipping into "Hear Me Talkin' to Ya." (Rinehart). Nat Hentoff and Nat Shapiro have compiled one of the most interesting and re-

* *283 B Reichelt Rd., New Milford, N. J.*

vealing books to emerge from the welter of material now available on the subject. In it the musicians themselves do the talking and the results are fascinating, to put it mildly. The language is rich and varied and should be required reading for anyone interested in the sounds of speech alone. The book represents the end product of fifteen years of collecting tape recordings, telephone conversations, writings, and just plain transcribed bull sessions, by musicians who played in New Orleans in the 1900's and Times Square in 1956. These comments are set down just exactly as they were spoken, bad grammar, repetition, and all. Just plain wonderful. There is a genuine feel of life on every page above and beyond the wealth of jazz material. As Orville Prescott pointed out in the New York Times some time ago, this book is truly Americana and should be a beginning and not the end of this sort of publishing. It has rhythm and a sort of classic epic quality. But above all, as far as I am concerned, the wonderful speech patterns and idioms are worth the price of admission many times over. Hear what Muggsy Spanier says as he tells of hearing Joe Oliver's Band in Chicago (Muggsy was fourteen!) "The band played in the Pekin Cafe, one of the worst gangster hangouts in Chicago, which has now been turned into a police station. In the summer the Pekin kept its windows open, so I'd sneak from home just about every night and sit outside on a curbstone listening to the music. Sometimes the goings-on would get rough inside, the music would stop and you'd hear the flash of forty-five caliber revolvers trying to fire with a beat. Before I knew it, I'd be running home as fast as my feet could take me. But the next night would always find me sitting on the same curbstone. I thought the music well worth running the risk of getting shot by a stray bullet." This has a real beat in itself. Hentoff, one of the compilers of "Hear Me Talkin' to Ya," is one of the finest jazz writers doing business today and he seems to bring to his subject a deeper realization of the place of jazz in the scheme of things on the whole rather than jazz as a thing apart from living. A good man and a fine book. We recommend highly.

Summer Slump

This is just about the time of year when the so-called Summer Hiatus takes place. This means that jazz label execs go off to Cape Cod and expect us poor peasants to go do the same and hence we should be watching O'Neill being done at the Provincetown Playhouse instead of sweltering in front of our hi-fi speaker or overheating our spleens in the listening booth at the record shop. They might be right but whether or no you can expect a sharp drop of output for the next few months. However, there will be a corresponding upswing in things called "Music for Summer Lovers," "Music for Lying in a Hammock." These will all feature purple album covers and string music to match. They will all sound exactly alike and, in fact, I suspect they are all recorded at the same session by an orchestra that uses eight different names and is released by eight labels simultaneously. Perhaps the companies get together on the thing to save costs. Stay

away. This sort of stuff only makes the summer seem hotter and certainly stickier. I guess a buck is a buck.

Some current goings-on on record, worthy of note:

BILLY TAYLOR "EVERGREENS" ABC-Paramount-112

Some of the best Taylor available on record. The sound is excellent and Taylor is in his usual tasteful restrained form. Here is one man who avoids cliche at all costs and always has a clean line in everything he does. Sometimes his understatement gets in the way of really getting the point home, but understatement has never been an objectionable quality as far as jazzmen go. A recommended disc.

JAZZ STUDIO 5 Decca DL 8235

Another in the series of "Studio Jazz" LP's bearing the Decca label and in some ways the most interesting of the lot to date. This session centers around the arranging talent of Ralph Burns. Burns is one of the most talented of the postwar crop of young arrangers and is most known for his work with the Woody Herman band, having been responsible for much of the Herd's better material for over ten years. Of late he has dabbled in legit theatre work and quite successfully too. Notable is the work of Joe Newman who plays trumpet in the set. Newman has been around for sometime and is just beginning to be really heard on recordings. Hear him especially on "I'll Be Around." A good sound. Incidentally, this is one of the rare releases that features the work of a tuba player for other than novelty purposes. Bill Barber is one of the finest tuba men to come around in years and he is heard doing some interesting things on "Royal Garden Blues." If you like arranger jazz, this is fine display of one of the top men in the field. Well recorded.

DUKE JORDAN Signal S1202

Another "forgotten" musician finally getting a well deserved hearing. Above all, Jordan swings and he swings without losing a grip on his technique or his emotions. He has had a formidable name for some time among musicians and a few knowledgeable jazz buffs and now for the first time his work will be heard by a larger public. This is one of the blessings of LP techniques and economics. By that I mean many people are today being heard who wouldn't have been recorded back in the days when the only thing that got a person a recording date was a "name" and a large following. A record worth hearing.

MODERN JAZZ FROM INDIANA Fantasy 3-214

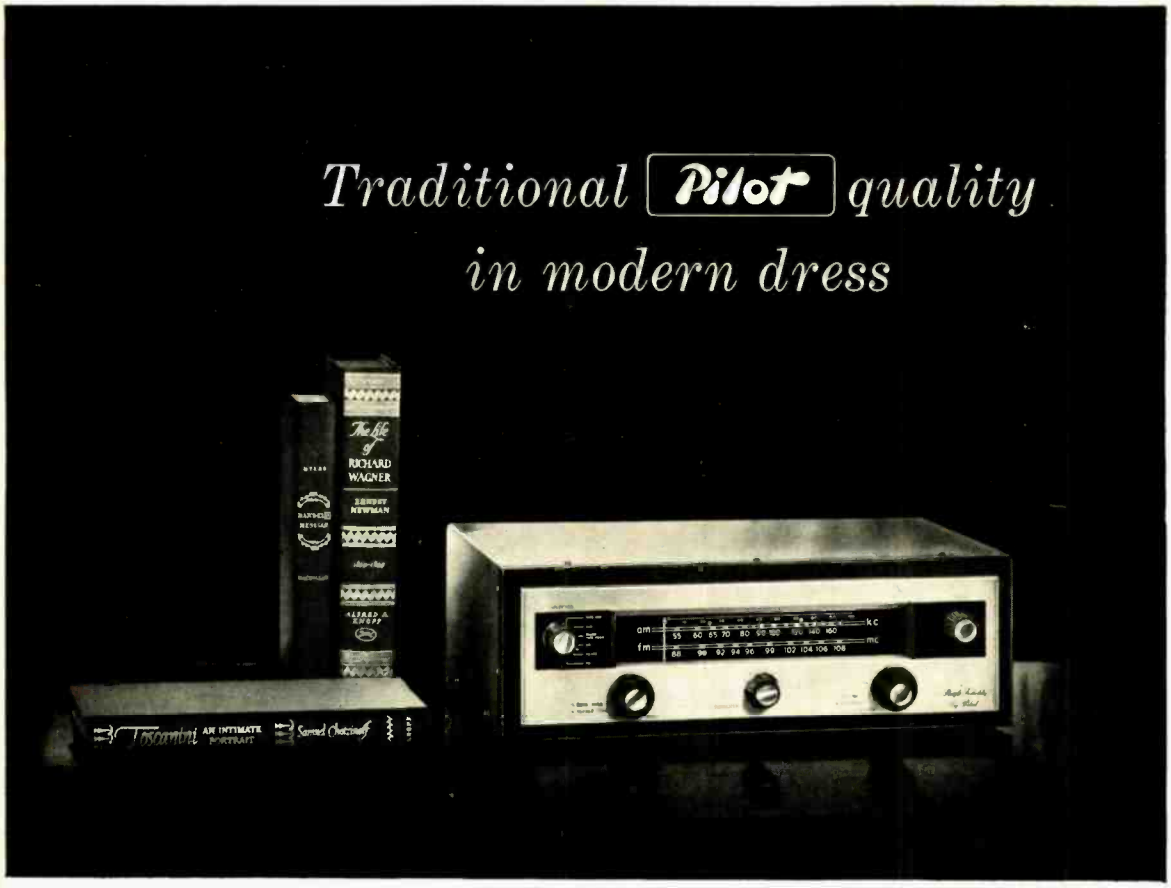
A tasty unobtrusive release built around the work of Jerry Coker who composes, arranges, and plays tenor. The influence of the Gerry Mulligan school of arranging is immediately obvious in the work of Coker. The "Indiana" refers to the fact that all concerned are in some way or another connected with Indiana University. The piano man has heard much Dave Brubeck. You might find this interesting.

A PAIR OF PIANOS ... Savoy MG 12049

The duo-piano team of John Mehegan and Eddie Costa, plus Vinnie Burke on bass. This recording was long overdue and is worth a good listen on several counts. Mehegan's technique is overwhelming and is nicely rounded off and polished by Costa who is much more than a shadow himself. Especially note the oddly compelling "I'll Remember April," a singular thing. Burke as usual is excellent. An interesting disc and well recorded.

THE DUAL ROLE OF BOBBY BROOKMEYER ..... Prestige LP 214

More of the work of one of the most talented young men around today. Brookmeyer is a fine valve trombonist who occasionally plays an easy piano as on this disc. He displays impeccable taste in his playing of both instruments and, in fact, I feel that occasionally his sense of good taste inhibits his ability to express more basic emotions through his music. Good stuff.



the NEW FA-550 FM-AM TUNER 159.50

with built-in phono and tape preamp

SLIGHTLY HIGHER WEST OF ROCKIES

Pilot has brought high fashion to high fidelity . . . distinctive modern styling to traditional Pilot quality.

The FA-550 is an impressive example of modern design . . . simple, graceful lines — color-contrasted in deep burgundy and burnished brass. And beneath its handsome exterior is quality . . . quality that speaks of more than two generations of Pilot experience in electronics.

The FA-550 is a precision-engineered high fidelity component — planned in every detail to provide you with flawless FM and AM reception. Among its features is the added convenience of a built-in preamp with facilities for both record and tape equalization. DC is used on all preamp tube heaters to insure hum-free performance. Also featured in the FA-550 are two concentric controls which permit independent bass and treble adjustment — and independent settings for loudness and volume.

The FA-550 offers you everything: stable, drift-free tuning — high sensitivity — and effective quieting action. And it delivers a clean, distortionless signal that is sure to enhance the overall performance of your high fidelity system. Hear the FA-550 at your hi-fi dealer, or . . .

Write to Dept. VG-1

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IN CANADA: Atlas Radio Corp., 50 Wingold Avenue, Toronto 10, Ontario

LETTERS

Corrections and Emendations

SIR:

The name of the tape-recorder manufacturer was omitted from my article "A Professional Hi-Fi Home Music System" in the April issue, and because it is the crux of the article and because practically all other brand names were given, I must point out that the recorder is a Stancil-Hoffman model R-5. This name is known primarily among broadcasters and motion-picture men, but it is an excellent unit even though not well known by the layman.

In order that no one be misled into thinking that a new or special speed, the error on page 24 wherein the speed of 17½ ips was named should be pointed out. The recorder operates at 15 and 7½ ips.

OLIVER BERLINER,
1007 N Roxbury Drive,
Beverly Hills, Calif.

SIR:

In my article "Transistor Bias Stabilization" in the May issue, there is one small error in the table. In entry #11 (page 41) the numerator should be αR_6 instead of the way it appeared.

PAUL PENFIELD, JR.,
752 Lakeside,
Birmingham, Michigan.

SIR:

Please—we did not show a short in our diagram from the two input grids to ground in the May issue, page 28. Your immediate attention and correction will be greatly appreciated.

Stan White, Inc.,
725 S. LaSalle St.,
Chicago 5, Ill.

(We *did. And we're sorry.* ED.)

The Last Word?

SIR:

I was delighted to see Mr. Badmaieff's reply (March, 1956) to my earlier letter, for he now admits that his "Bitlex principle" (Nov. 1955) is not his invention at all. His citation of priorities to my claim of having introduced a workable cone compliance system in 1938 does not excuse his own ignoring of all earlier workers' efforts. In any event, patent specifications in themselves do not necessarily prove anything except that someone has been thinking. Any patent examiner can testify that weird things come before him, and speaker patents are a tortuous maze of ideas and inventions, many of which could not work, but which, by existing legislation cannot be refused. When I made my application, British "anticipations" were quoted so as to clarify the complete specification, but it so happens that I did not take out a U.S. patent. However, my method of using cone compliance is generally recognized as the first practical system to achieve the desired results.

Your readers will know, of course, that I made no comment on Mr. Badmaieff's mathematics. All I said was that his analogue could be proved by practical test to bear no relation to the actual performance of the speaker it was supposed to represent.

As for the voice-coil compliance, of course it is well known, for many thousands of 215 speakers are in use throughout the world, especially in the United States. The real originator of this idea is A. C. Barker, who arranged with the British Magnavox Company (in 1937, I think) to produce the Magnavox Duode 66. At that time I was working on a similar device, and with the approval and co-operation of the Magnavox Company I developed along my own lines. Then, as now, the only speakers that have this principle are those made by Mr. Barker and myself.

Finally, I cannot see why he should introduce the red herring of a dust cap, which I never even mentioned. Dust caps don't keep the dust out. If they were dustproof they would also be airtight, and then what would happen to the speaker's response? Some of my speakers have been working without attention for 20 years, and there is no dust in the gap because a freely suspended cone blows the dust out! It is as simple as that.

H. A. HARTLEY,
62, Latymer Court,
London W.6. England.

Only the PRESTO SR-27 Tape Recorder gives such Professional Performance at such a popular price!

The top performance features of the finest PRESTO units are yours in this 2-unit combination—R-27 tape recorder and A-920B amplifier. *Check the features of the recording unit:* 3-motor drive; separated record, erase and playback heads; fast forward and rewind. There's no take-up reel clutch or idler pulley. *Compare the features of the companion amplifier:* 10 watt output at 16 ohms, self-contained power supply, separate preamps and VU meter and *two* playback speakers. You can monitor the tape during recording. This professional performer is yours for just $588 complete.

PRESTO *Pirouette* T-18 TURNTABLE

. . . finest low-priced professional turntable has world-famous flick shift—one sideway flick selects any speed.

There is no finer, smoother-running or easier-to-operate instrument for control room, studio or hi-fi system than the *Pirouette* T-18—the PRESTO achievement that sets a new high in turntable design. You select any speed—33⅓, 45 or 78 rpm—with a sideway flick of the exclusive PRESTO 3-speed shift. You engage the proper idler for the speed you want with one motion. There are no bothersome arms or shift cams. And check the extras you get: extra heavy-weight wide-beveled table, deep-well bearing, sleek styling in telephone black and brushed chrome. . . . Net price $66.00. With hysteresis motor, . . . Net price $117.00.

It's Here! the NEW PRESTO K-11 DISC RECORDER

. . . improved professional version of PRESTO's all-time favorite K-10—incorporates revolutionary T-18 turntable . . .

K-11 is the smart new disc recorder you can fit into your sound system — or use as an on-location recorder. It's featherweight with a completely new pick-up arm, fully encased hi-fi speaker, smart new panel design with push button controls and the dependable PRESTO cutting head. You get excellent broadcast-quality fidelity. For those times when a disc recorder is preferable, the K-11 is your best bet. Cuts discs up to 13¼ inches in diameter. Three-speed operation. *With hysteresis motor* . . . Net price $445.00

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PARAMUS, NEW JERSEY

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WORLD'S FOREMOST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

AUDIO ETC.

Edward Tatnall Canby

Standard Recording and Stereo

THERE'S NO DOUBT about it, all the signs now point, somewhat hysterically, to a new revolution, the Coming of Stereo. Stereo* sound will be entirely on tape, by every indication, rather than on disc. The tape recorder makers are betting on that with their new stereo attachments and stereo tape phonographs. Stereo tape is going to make a new place for itself that will clearly be unique, distinct and separate from the other two dominant categories of present recorded sound, disc and standard tape—both of them one-channel, "monaural" or conventional recording.

Stereo is still largely behind the scenes, though it's been out in public to a limited extent for a number of years and is on the market already in a number of tape brands. For every tape now available or announced in public there are now, I'd guess, a hundred or so held back in reserve, waiting for the "if and when." Many a record company and many other firms have been experimenting with stereo recording for a long while, unofficially. Large libraries of two-channel master tapes lie in the vaults or the files or whatever you call them, for publication when the moment arrives, though most companies aren't even admitting their existence yet, in public.

Moreover, a good many of these libraries are already being processed for duplication and public sales. Catalogues, boxes, album notes and the rest are being worked out, sales distribution set up. All behind the scenes, as of this writing, except for the relatively few labels that have so far come out with stereo on public sales. But by autumn things should have begun to break. Then we shall see what we shall see!

Here, then, are some points that need to be made clear at this pre-revolutionary stage of the game.

1. Stereo on Tape

Stereo will be on tape. That, anyhow, is my guess as well as that of others who are gambling their commercial souls on it. Stereo on long-play-length disc is, perhaps, possible. But not without too-drastic compromises, as far as I can figure it, in the sound quality. Tape, with two tracks side by side, is inherently the ideal medium. Disc is inherently unsuitable for two simultaneous tracks that must be precisely synchronized. And so in the stereo field there will not be the alternative— disc or tape— that is presently possible in the standard recording field. Stereo is a tape exclusive, which in itself puts stereo tape in a sharply different category from standard (one-channel) recorded tape.

Whatever advantages stereo has to offer will be available exclusively on tape. These advantages will therefore be the unique selling point that will justify stereo's special pricing, at present considerably higher that for a given length of play than either disc or standard tape. The difference is, again, not merely "more" quality at a higher price, but a special kind of quality, unique and unavailable in any other way. A unique kind of tape.

2. Disc, Tape and Stereo

Therefore, we will have three distinct categories of recorded sound, each with its values. We will need to think of them separately, and each will have its own special appeal, its own type of market, its own price scale. The three are:

1. Disc Records.
2. Tape records.
3. Stereo tapes.

At present, you will note, we tend to think somewhat differently. We make two main categories—disc and tape. It is assumed that these are alternatives, often for the same original recording. Buy it on disc, for cheap, dependable, convenient hi-fi quality. Buy it on tape for better quality all around, at a higher price. (Or buy it on tape because you already have a tape machine conveniently ready to play.) Buy it on tape, also, for unobstrusive, long-play background music without mechanical changer inconvenience.

We lump all tapes together, and so, for the most part, do the issuing companies. Indeed, some performances are alternately available in all three forms, such as RCA Victor's recent three-way releases, on LP, standard tape and stereo tape.

But do not forget that all types of record *except* the stereo have a common standard master. The stereo has its own separate dual-track master, made differently, miked differently. You can make a monaural recording out of a stereo (and it is often done) combining the two tracks. But you can never make a stereo record out of an existing monaural tape. Stereo means a completely new start.

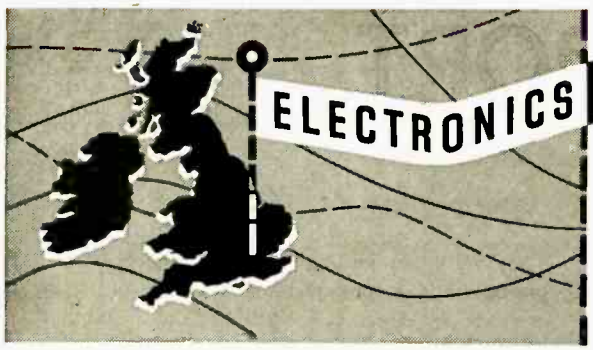
3. Disc Markets and Tape Markets

Of these three types, disc, tape and stereo tape, the first two are now reaching into quite remarkably different areas—as already suggested in this column in the past —and this in spite of the duplication of recorded material between the two. In actual practice, the same recording may find utterly different markets and different uses, according to the medium.

This may seem very strange to those who

(*Continued on page 52*)

* *Sometimes incorrectly called "Binaural."*



The British Electronics Industry is making giant strides with new developments in a variety of fields. Mullard tubes are an important contribution to this progress.

EF86

Another Mullard contribution to high fidelity

The Mullard EF86 audio frequency pentode is one of the most widely used high fidelity tubes in Britain today. It has been adopted by the leading British manufacturers whose sound reproducing equipment is enjoying increasing popularity in the United States and Canada.

The marked success of this tube stems from its high gain, low noise and low microphony characteristics.

By careful internal screening, and by the use of a bifilar heater, hum level has been reduced to less than 1.5μV. Over a bandwidth of 25 to 1,000c/s equivalent noise input approximates 2 μV.

When operated below 1,000c/s, internal resonances of the EF86 are virtually eliminated. Even at higher frequencies chassis and tube socket damping are usually sufficient to make vibration effects negligible.

Supplies of the EF86 are now available for replacement purposes from the companies mentioned here.

Principal Ratings

Heater	6.3V, 0.2A
Max. plate dissipation	1W
Max. screen dissipation	0.2W
Max. cathode current	6mA

Characteristics

Plate voltage	250V
Screen voltage	140V
Grid voltage	−2V
Plate current	3mA
Screen current	0.6mA
Transconductance	1800 μmhos

Base

Small button noval 9-pin

Supplies available from:—

In the U.S.A. International Electronics Corporation, Dept. A7, 81 Spring Street, N.Y.12, New York, U.S.A.

In Canada Rogers Majestic Electronics Limited, Dept. 4K, 11-19 Brentcliffe Road, Toronto 17, Ontario, Canada.

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EDITOR'S REPORT

MORE ABOUT FM

THE FM RADIO SERVICE does have many boosters, judging from a number of letters received with comments about our story on this page in the June issue which delineated the efforts of a Philadelphia TV outlet to eliminate a portion of the FM band to provide for another TV channel. Naturally we are not in favor of any encroachment of the FM band, since we feel that this form of broadcasting offers many advantages over AM anyhow, and that the public consumption of radio hours *vs.* TV hours should be considered. We firmly believe that radio is far in the lead on this score.

One reader complains about FM broadcasting with the comment that the quality is not any better, the programs are duplications of AM broadcasts, and the sets themselves are more expensive. Quality may not *be* better on some stations, but the system itself permits transmission of a greater frequency range without so much disturbance from atmospherics and certain forms of man-made static. Certain parts of the country do not have any trouble from atmospheric disturbances over the majority of the year, if at all, because they are free from lightning storms. However, there are plenty of sections where the summer is a time when AM radio reception is practically unusable. Furthermore, most types of man-made static do not affect FM appreciably.

It is often stated that AM stations are required to limit the upper end of their frequency spectrum to 5000 cps to avoid interference with stations located on adjacent bands. This is not entirely true. In some instances, stations may be so limited because of special circumstances, but there are no specific restrictions which apply to all AM stations. In fact, we have heard some AM receivers working in high signal-strength areas which had quality fully equal to that from the FM counterparts on the same programs from the same studios. But the acceptance of a wide frequency band brings with it the acceptance of more atmospheric static, and receivers of this type are usually unsatisfactory unless operated in a signal-strength of around 100,000 microvolts.

Of course there can be no improvement in the transmitted (and received) signal if the bottleneck is in the studio equipment of the radio station. Fortunately, most of the good-music-station broadcasters are extremely conscious of their audio quality, and practically all of them are using the highest grade of pickups, turntables, and amplifiers. Strangely enough, the pickups and amplifiers built for home use today are even better than their professional counterparts—which is a surprise when one considers that in early days of hi-fi (which means back in the early '30's) most of us did our best to acquire broadcast equipment for home use and when we got it we felt that we had attained the ultimate. Nevertheless, the broadcasters who are most particular about their quality today are likely to be using the same pickups that we use in our homes, and throughout their entire systems they take every care to have a wide frequency range and a minimum of distortion.

To be sure, FM receivers are more expensive than *some* AM sets, but when we go to additional trouble to ensure a wide frequency band and low distortion in an AM tuner, we are likely to find that the price is increased appreciably over the usual $12.95 radio set (for which we are asked to pay $29.95). It's the old story—we are likely to get just what we pay for.

It does seem unfortunate that it is not possible to build quality into a product for low cost, but it certainly seems to be a fact, however we look at it. It's strange, for example, that walnut and mahogany—which are such fine woods for furniture because of their appearance and their hardness—should be the scarce woods, while the softer and less attractive pines and firs are abundant and thus comparatively inexpensive (or have you bought enough 5-ply fir lately for a big speaker cabinet?).

SUMMER, AIR CONDITIONING, AND SHOWS

Summer has arrived with a bang, at least here in the East where Arthur Godfrey recently mentioned that we had a fine Spring—one day. But we remember the hi-fi show in Chicago of several years ago when the temperature was over 100° every day. The forthcoming New York High Fidelity Show, presented by the Institute of High Fidelity Manufacturers, is earlier in the year than the Fall shows have been in New York heretofore, and it is expected that it might possibly be hot at that time, with all the attendant misery. But we had the opportunity of attending another show in the New York Trade Show Building a few days ago, and we were relieved at the effectiveness of the air conditioning throughout the building. This year we should have a comfortable New York Show. Remember the dates—September 27–30.

MODEL 580. 1000-CYCLE CROSSOVER / MODEL 581. 400-CYCLE CROSSOVER

THE PICKERING ISOPHASE is a revolutionary new speaker with a single diaphragm that is curved and virtually massless. This diaphragm is moved or driven as a unit by an electrostatic field. It re-introduces an audio signal into the air at a low velocity to closely approximate the unit area energy of the sound at the microphone in a concert hall or studio, thereby creating a "window-on-the-studio" quality that is breathtakingly realistic. Conventional cone or dynamic type loudspeakers reproduce sound by moving only small amounts of air at high velocities. The ISOPHASE, with its large sound-generating surface, is a radical departure from the older concept.

The ISOPHASE is available in two models. Model 581 covers the musical range from 400 cycles per second up to well beyond the limits of human hearing. The response over this range is consistent and absolutely uniform—without the slightest bump, peak, or resonance of any kind. This in itself is an unprecedented characteristic for a loudspeaker.

Model 580 has the same uniform response and clarity starting at 1000 cycles per second and similarly going out to supersonic frequencies.

Using an ISOPHASE SPEAKER with a FLUXVALVE PICKUP, recorded sound is reproduced for the first time *without distortion caused by the frequency characteristics of the transducers* . . . the middle and higher frequencies are recreated with a smoothness, definition, and degree of balance never before achieved with any speaker.

PICKERING & CO., INC. OCEANSIDE, N. Y.

Professional Audio Components

"For those who can hear the difference"

. . Demonstrated and sold by Leading Radio Parts Distributors everywhere. For the one nearest you and for detailed literature: write Dept. A-11

EXPORT: AD. AURIEMA, INC., 89 BROAD ST., NEW YORK / CANADA: CHARLES W. POINTON LTD., 6 ALCINA AVE., TORONTO

Transistorized telephone summons you with a musical tone

Above: Experimental model resembles regular "500" set; the only visible departure is a louver in the base through which the musical tone is radiated.

Bell scientists have developed a new musical tone device which may some day replace the telephone bell, if it meets technical standards and customers' approvals.

Because the musical tone equipment uses transistors, the tones will be transmitted with the same amount of power required to transmit a telephone conversation — considerably less than is needed to make a telephone bell ring.

The experimental telephone sets resemble the current "500" sets; the only external difference is a louver at the side of the base through which the tone is radiated by a small loudspeaker mounted inside the telephone's base.

Tests have shown that the musical tone can be heard at great distances. It stands out above general room noise and can be distinguished from such sounds as ringing of doorbells, alarm clocks, and home fire alarms.

This new low-power signaling technique is expected to play an important part in the electronic switching system now under development at Bell Laboratories.

Above: Bell ringer has been displaced by a small loudspeaker in transistorized telephone. Left: L. A. Meacham heads the team of engineers that developed the musical tone ringer. Mr. Meacham holds a B.S. in Electrical Engineering from the University of Washington, Class of '29. He became affiliated with Bell Labs a year after his graduation. In 1939 Mr. Meacham won the "Outstanding Young Electrical Engineer" award of Eta Kappa Nu.

BELL TELEPHONE LABORATORIES

World center of communications research and development

Transistorized A-M Tuner Conversion

EDWIN BOHR*

Quality of reproduction at the detector of an inexpensive AM receiver is likely to be sufficiently good to serve as the source for a hi-fi system, provided it is fed to a good amplifier and speaker system. This simple method of connecting eliminates chance of hum being introduced when an a.c.-d.c. receiver is used.

WHEN THIS AUXILIARY, transistorized, low-distortion, second detector is added to your radio, it will have two personalities. The radio can be, at will, either a high-quality AM tuner, or, as originally intended, just another table-model radio.

The AM tuner feature is especially useful for late evening listening. After midnight many of the high-power, clear-channel, AM stations feature good-music programming. These quality AM stations use the tops in reproducing equipment and have fabulously diverse libraries of transcriptions and hi-fi recordings. The program production is usually excellent and advertising is definitely the "low-pressure" kind.

Too, during these late hours the broadcast band is relatively free of the early night-time chirping and chatter. Try these "midnight-to-dawn" classical music programs. We advise a Saturday night. Once you start listening, you may not get to bed until the station fades out with the coming of dawn.

The transformation to AM tuner is affected by adding a "second" second detector. This auxiliary detector, as we will call it, is tubeless, extremely small, and completely isolated from both the receiver power supply and chassis.

Even a.c.-d.c. radios can be successfully and *safely* converted to AM tuners. Now don't scoff! The a.c.-d.c. chassis really can be adapted to a creditable AM tuner. Of course, better engineered sets with power transformers can produce even better results.

The modification does not change the normal receiver operation. There are no extra knobs or switches. No change is made in the original audio system. For these reasons, the conversion usually can be made without complaints from the household's better half.

A miniature terminal board, at the rear of the cabinet, is the only external change in the radio's appearance. From this terminal board, the audio is piped to the hi-fi power amplifier. The impedance is low enough to feed over 100 feet of shielded cable without undue treble attenuation. Also, the low impedance means that hum pickup is practically nonexistent.

* *1708 McAllister Drive, Huntsville, Alabama.*

Detector Distortion

The concepts necessary for a full understanding of AM detector distortion are not easily grasped. It seems almost paradoxical that so "simple" a circuit, as the AM detector, should require such abstract thought. But an exact analysis, we believe, would require more time than most readers would care to spend. However, anyone who builds this detector should have a nodding acquaintance with the factors governing harmonic distortion. For this reason, a brief and perhaps oversimplified description will be given for each of the sources of distortion.

If one is interested in the "whys" and "wherefores" of AM detectors, several very thorough explanations are available.[1, 2, 3] The following information and rules-of-thumb nevertheless should be of general interest.

The diode itself is a source of distortion. Neither the vacuum or semiconductor diode is an ideal detector. For example, there is always a forward-conduction voltage drop across the diode. This forward drop is nonlinear with respect to the signal level particularly so at small carrier amplitudes. Nonlinearity of type generates second-harmonic distortion. The most expedient way to reduce this distortion simply involves feeding a very large carrier, say ten or more volts, to the detector.

Distortion also results from the r. f. filtering capacitors between the detector

[1] Langford-Smith *et al.*, *Radiotron Designer's Handbook*, Chapter 27.

[2] Vincent C. Rideout, *Active Networks*, pp 350–362.

[3] *Applied Electronics*, E.E. Staff, Massachusetts Institute of Technology, pp 654–663.

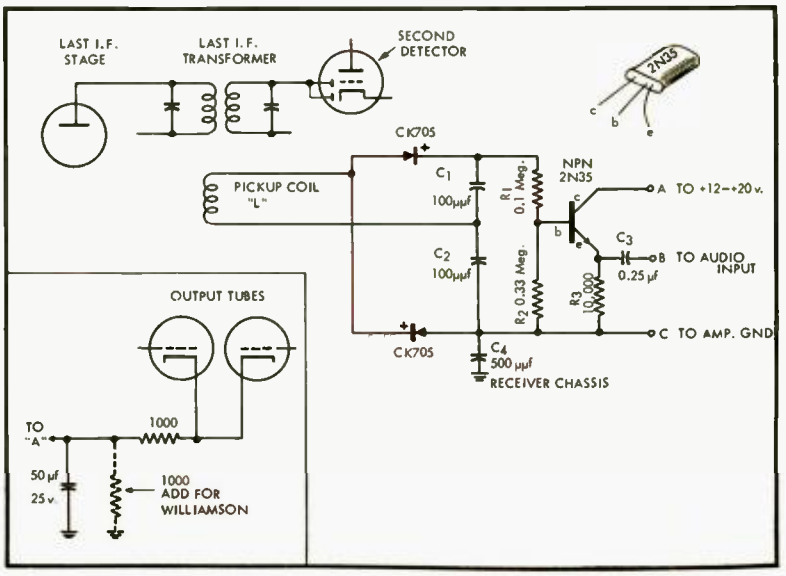


Fig. 1. Schematic of the changes to be made to an inexpensive AM tuner and the addition of a transistor "output stage" to feed a high-quality amplifier and speaker system.

and first audio stage. These capacitors should smooth out the r. f. ripple, yet be able to follow the fastest change in carrier modulation.

The filter capacitors can charge quickly on positive modulation peaks since the detector is a low impedance source of charging voltage. On the other hand, to follow negative peaks these capacitors must *discharge* through a high-valued load resistance. If the capacitors can not discharge fast enough, they no longer follow the modulation envelope resulting in a negative-peak-clipping distortion.

To mitigate this distortion, a low value of filtering capacitance and/or load resistance can be used. But, decreasing the load resistance too much accentuates other distortion factors. Similarly, reduced filtering capacitance lowers the detection efficiency.

In our transistorized detector we use a full-wave detector circuit to double the carrier ripple rate. This allows the filtering capacitance to be reduced without loss of efficiency.

Shunt Loading

A third effect, called a.c. shunt loading, results in the greatest amount of distortion. When a.c. shunt loading exists, the detector, while the carrier is modulated, sees a lower load impedance than it does when the carrier is not modulated. *RC* coupling to the following audio stage and the a.v.c. system both can contribute to shunt loading.

Here is what happens. When the carrier is unmodulated, the detector develops a constant d. c. voltage proportional to the carrier level. This voltage causes a current to flow *only* through the detector load resistance. As the carrier is audio modulated, however, current also flows through the coupling capacitor and following grid resistor. The grid resistor is then effectively in parallel with the detector load resistor.

The a.v.c. system behaves in the same way although the resistor and capacitor causing the shunt loading are in a somewhat different circuit arrangement. The a.v.c. loading is removed by simply separating the functions of detector and a.v.c. rectifier.

Shunting from the following audio stage can be reduced simply by making the grid resistor many times larger than the d.c. load resistance. In an effort to reduce distortion it is common to use a load resistance of 0.5 meg and a grid resistor of 10 megohms.

An interesting circuit appearing in the *Radiotron Designer's Handbook*, for all practical purposes, eliminates shunt distortion by direct coupling the detector to a cathode follower. The cathode-follower buffer offers considerable merit, but it was unsuitable for our purpose.

We wanted to use a small a.c.-d.c. radio as the combination tuner and radio. There was not enough room on the chassis for another tube unless, perhaps, a subminiature tube. Furthermore, using tube meant power would have to be supplied to the heater and plate either from the receiver, or externally from the amplifier. This, we felt, would be undesirably cumbersome. So, we decided upon the circuit of *Fig.* 1 more suitable to our purpose but still resembling the Radiotron circuit.

The circuit is beautifully simple. There is no need for external filament power and it is small enough to fit into just about any chassis.

Fig. 2. The simplest kind of a.c.-d.c. receiver serves as an inexpensive tuner of good quality for AM reception.

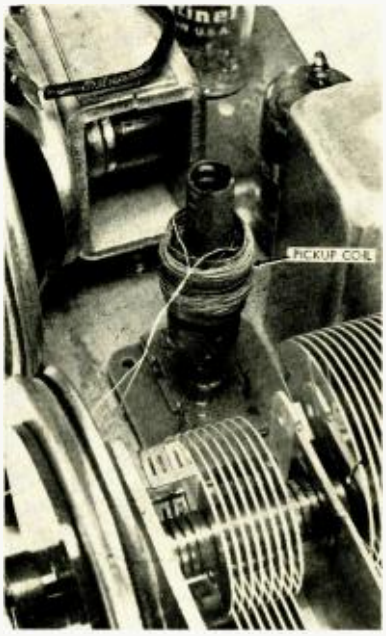


Fig. 3. Method of appliqueing a pickup coil to the last i.f. transformer.

The auxiliary-detector feature automatically separated the a.v.c. and detector functions. The problems of shunt distortion and the feeding of a shielded cable were both solved by using a grounded-collector transistor circuit. Grounded-collector transistor circuits are characterized by high input resistance and low output resistance. Thus, in most respects, the grounded-collector circuit is a dual of the cathode follower.

Since positive voltage is available in all vacuum-tube amplifiers, a n-p-n alloy-junction transistor was chosen for the grounded-collector circuit. A p-n-p transistor would have presented a power supply problem because it must have a negative voltage.

Generally, the cost of n-p-n transistors has been prohibitive but the price of the Sylvania 2N35 has just recently been reduced making it competitive with the better p-n-p transistors. The 2N35 is a low-noise, high-gain, high-quality unit available from most mail-order houses.

The diodes, C_1, C_2, and C_4 are mounted on a terminal board inside the receiver cabinet next to the last i-f can. Because of the high temperatures inside the radio cabinet, the transistor and the remaining components are mounted on the outside. With the transistor mounted on the outside, only a few millivolts appear between the transistor base and ground. This small voltage is not enough to affect detector operation appreciably.

Construction

Construction is simple. To make matters even more simple, we built our model on specially staked terminal

(*Continued on page 39*)

Input Transformer Design

NORMAN H. CROWHURST*

Continuation of the discussion of amplifier performance as related to input transformers and their design characteristics.

We will now consider the effect of the reactances which the transformer will contribute. The primary inductance will add a further low-frequency loss element which will make the ultimate slope at the low frequency end in the region of 18 db per octave. This is because it is combined with the source and load capacitances as the other reactance elements for the low-frequency roll-off. Leakage inductance, acting between input and output capacitances, will similarly introduce an 18-db-per octave ultimate rolloff characteristic. The relevant circuits are shown in *Fig.* 8.

Apart from the restricting influence that this will have on the effective frequency bands that could be designed into such a transformer, there is also the practical difficulty of designing a unit that will have a smooth rolloff characteristic at both ends for the required frequencies. Any effort to complete such a design proves that it is impossible to achieve any practical step-up while maintaining a reasonable degree of fidelity.

However the fact that an *ideal* step-up is possible means that such matching can be arranged for a relatively narrow frequency band, and hence might be worth considering for such an instrument as a hearing aid. The factor to consider then is whether the transformer would contribute sufficient extra gain to be worth its additional cost as compared with other methods of picking up gain. In hearing aid work, the reason for which an input transformer is usually employed in high-quality reproduction does not obtain; background noise is not an important factor here.

Practical Design

Having explored the possibilities of a transformer as an ideal component, we ext have to consider design of a practical transformer. The first thing to do is to select a suitable core material and core configuration.

As input transformers invariably have to operate at extremely low level and hence low flux density, the important feature about an input transformer core material is that it shall have high initial permeability. The initial permeability of a magnetic material is controlled by the magnetization characteristic of this material in its first stage. According to currently accepted magnetic theory, the first stage is explained as being due to the more close alignment of those crystal lattices in the magnetic structure that are already approximately oriented in a major direction corresponding to the direction of magnetization.

The achieving of a high permeability in this region must rest, according to this theory, upon complete relieving of molecular stress within the material, and in practice this conjecture is substantiated. Materials developed to have high initial permeability require special annealing to relieve every vestige of molecular stress within the material. This is the principal reason why these particular alloys are expensive. Not only do the materials that go to make up the alloys have to be blended with chemical purity and precision but after the material has been worked such as by rolling and stamping it, a costly annealing process has to be applied.

To date the highest initial permeability has been achieved with nickel iron alloys, in a combination that, with proper annealing, gives initial permeabilities better than 10^5. These alloys also have relatively high resistivity, to give low eddy-current losses, but this is not usually very important on input transformer design, for which reason it is unnecessary to go to the extremely thin laminations.

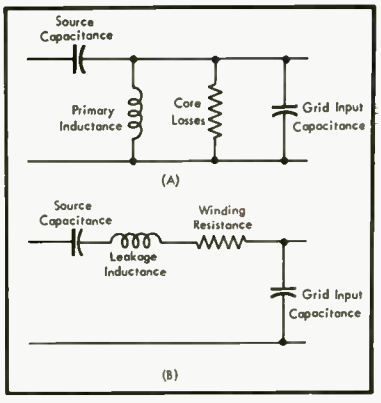


Fig. 8. Equivalent circuits for the low- and high-frequency response of a transformer operating between capacitive source and load. (A), the equivalent for low frequency response, and (B), the equivalent for high-frequency response.

Grain oriented materials do not seem to give appreciably better initial permeability than the simple heat treated nickel iron alloy, so there is no point in going to the C core construction for input transformers.

The next problem is the selection of a suitable core shape. The factors determining shape are: (a) primary inductance; (b) leakage inductance; (c) winding capacitance.

The shape has to be so chosen as to give a maximum value as of (a), consistent with minimum value of (b) and (c). Where (c) can be neglected, as with output transformers and other transformers working at lower impedances on both sides, selection of shape can readily be reduced to a theoretical economic basis, as described in an earlier article on transformer design. ("Audio Transformer Design," Audio Engineering, Feb. 1953). But when capacitance enters the picture the problem is no longer so simple.

In addition to the theoretical factors listed above, there is the practical limitation imposed by the smallest gauge of wire that can be wound with the equipment available. This limits the maximum number of turns that can be gotten into a given winding crossectional area. When applying a purely mathematical theory for optimum shaping, this does not take into account physical limitations of wire gauge, but assumes a wire may be drawn and wound on the bobbin as thin as may be dictated by the mathematical solution.

The writer has found a useful approach in the tabulation of various data about certain available cores, which fall in a general group suitable for this purpose, as shown in *Fig.* 9. For the purpose of the tabulation, it is assumed that the transformer will be wound as full as economically possible with two windings occupying equal winding area. One of these windings is assumed to have 1000 turns of a wire gauge chosen so as to fill its one half of the available

* *150-47 14th Road, Whitestone 57, N. Y.*

area and the various losses are referred to this winding.

The d.c. resistance of this winding is calculated and the core losses due to eddy current are referred to it. This information will give a figure of power transfer efficiency (when the secondary is loaded), and also a value for efficiency when unloaded on the secondary. In the first case, the loss in both windings will contribute to the series losses, while in the second case, the loss in the primary winding only is compared with the referred core losses. A working impedance is evaluated for the 1000 turns such as to enable the transformer to operate at maximum power transfer efficiency. This working impedance for a 1000-turn winding can then form the basis of a theoretical frequency response for this type of core. Primary inductance is evaluated from data on the core material, and the 3-db point with this working impedance entered on the table. Leakage inductance is similarly computed with the aid of *Fig.* 10, and referred to this same 1000-turn winding, from which a 3-db point for the upper end of the response is evaluated.

Next calculate the maximum numbers of turns that can be put into the other half of the winding space, using the finest gauges of wire that can be wound successfully on this type of bobbin. These numbers are used in conjunction with the working impedance obtained for 1000 turns to evaluate the maximum referred impedance on the secondary side and the winding capacitance of these turns, from *Fig.* 11. This tabulation is then very useful for applying in practical design.

We shall not necessarily calculate the number of turns on the basis of this theoretical optimum. It may be that the low-frequency rolloff point listed is not low enough, while the maximum available step-up listed gives an impedance which will produce too much loss at the high-frequency end, due to winding and grid input capacitance. If this is the case then a larger number of turns can be used for the working impedance required, which will give a better inductance than that based on the theoretical maximum efficiency condition, and will also reduce the available step-up so that the working impedance in the grid circuit is lower and hence the high-frequency response acceptable.

Alternatively, a core having an exaggerated core cross section compared to winding area may give a low-frequency rolloff point which is unnecessarily low and, due to the restricted winding space, may limit the step-up so that the high-frequency response is also unnecessarily good. In this case a lower number of turns can be used to represent the desired working impedance, so as to enable a higher step-up to be obtained, bringing the response range down to something that is still acceptable, although we have increased the effective gain of the transformer.

Having selected a suitable approach the design should be completed out, the primary inductance, leakage inductance and winding capacitances calculated, and the whole frequency response computed with the aid of *Figs.* 4, 5 and 6.

It may be found that the combination of parameters results in a peak at the high-frequency end of the response which will need attention by use of resistance loading. Usually this means that the transformer has been made unnecessarily good, in the sense that too much good material has been put into it. A smaller transformer, using a more slender core cross section, with a greater number of turns, will usually achieve as good a response with less material cost and in addition without the necessity of resistance loading on the secondary.

The important thing to notice in designing an input transformer is that *it is designed for a specific circuit condition.* It is a pity that many manufacturers' catalogs do not indicate precisely the circuit condition for which the transformers are designed.

From the way the catalogs list them, it would appear that a 50:1 step-up transformer from a 50-ohm microphone is designed to be terminated with its matching impedance of 125,000 ohms. In a small transformer, with an efficiency

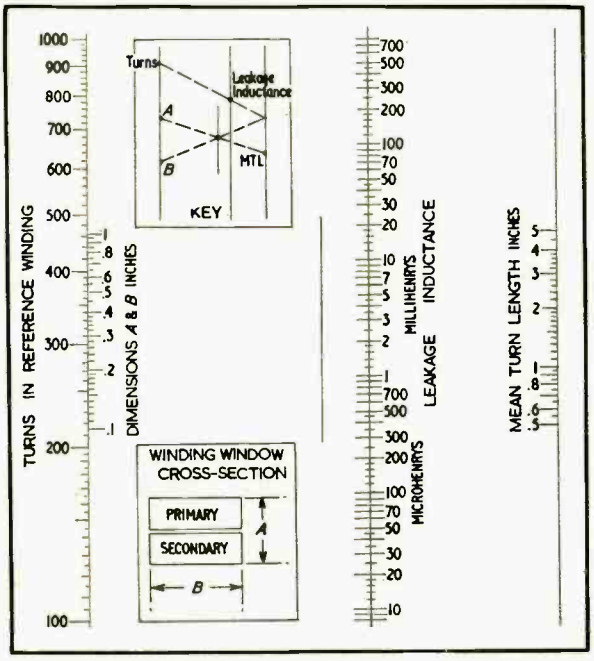
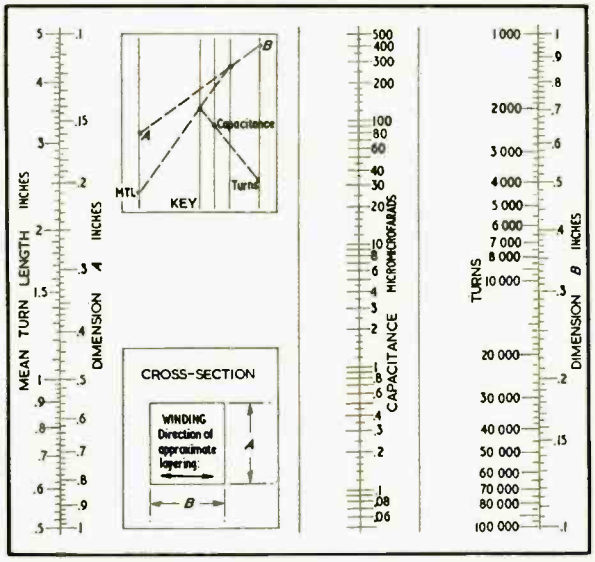


Fig. 10 (left). Chart for calculating the leakage inductance of simple double-wound transformers. This chart assumes that the spacing between the windings is negligible compared to the winding dimensions themselves. Inductances referred to windings outside the range from 100 to 1000 turns can be calculated by using a number that is larger or smaller than the desired number by a multiple of 10, and then multiplying or dividing the result from the chart by the same multiple of 100. Fig. 11 (right). Chart for calculating the self capacitance of a random-wound winding. This chart does not include capacitance from one winding to another, or to core, which can be computed from recognized formulas separately. If the coil is impregnated, the result should be multiplied by the dielectric constant of the compound used.



CORE DESIG-NATION	MAXIMUM EFFICIENCY		CONDITION OF COLUMN 2						
	Power Transfer %	Step-up %	Impedance for 1000 turns ohms	Low frequency 3 db pt. cps	High frequency 3 db pt. kc	Maximum Impedance #42 AWG	Maximum Impedance #46 AWG	Winding Capacitance #42 AWG	Winding Capacitance #46 AWG
1	2	3	4	5	6	7		8	
A	87.5	99.6	1120	30	20	.4 M	.1 M	28 μμf	17 μμf
B	89	99.7	3400	25	80	.12 M	.3 M	85 μμf	50 μμf
C	87.5	99.6	1800	30	60	.18 M	.4 M	30 μμf	20 μμf

Fig. 9. Method of tabulating data about regular core sizes used for input transformers to give a quick first approach to design. The significance and method of deriving the various columns is described in the text.

probably not better than 80 per cent under maximum energy transfer matching conditions, this results in 2 db loss. This is probably not the method of operation intended, but if it were, a better input transformer could be designed, not to require such heavy resistance loading and so that the secondary could be operated directly into the grid without a shunt resistance. This design would avoid the 2-db loss and probably get a bigger step-up ratio as well.

However, it is suspected that in most instances *the quotation of an impedance figure for the secondary is merely an alternative way of prescribing the step-up ratio.*

In the writer's opinion a successful specification of an input transformer should state:

(a) the source impedance for which it is designed,
(b) its step-up ratio, and
(c) the resistance, if any, which should be placed across its secondary to obtain optimum frequency response.

Multiple Inputs

A special type of input transformer requires to be operated with more than one input source. Here the choice of winding arrangement will again depend on the circuit components with which the transformer is to be used.

If the secondary can be operated unloaded, except for the grid input capacitance, and if, with all the input source impedances used, the leakage induction is unimportant, then the winding arrangement used to provide for alternative inputs is also unimportant. A tapped winding may be used or two separate windings, whichever suits the mechanical details of circuit configuration best.

But if the secondary has to be loaded to achieve the necessary uniformity of frequency response, the best arrangement is to place one winding inside and the other winding outside the secondary so that each of the primaries is closely coupled to the secondary winding.

In many applications an input transformer has only to be designed for one or two specific impedances which are determined beforehand. But occasionally it is desirable to design an input transformer for use with an amplifier to provide a wide variation of input matching to suit any possible impedance that may arise. With an input transformer it is not usually necessary to provide precision matching for a specific impedance. Any matching within a 2:1 range should be sufficiently close. Also the close control of leakage inductance is not vitally important. For this reason an input winding can conveniently be constructed on a tapping arrangement as follows:

Starting with a winding with a single tapping, such that the number of turns between the tap and one end is 1.6 times the number of turns between that tap and the other end, this will accommodate three different impedances spaced in geometric progression, at a ratio of approximately 2.6:1. Suppose the lowest number of turns is 10 and the other part of 16 turns, makes a total of 26 turns. If the 10 turns represents an impedance of 1 ohm, the 16 turns will represent an impedance of 2.6 ohms while the 26 turns will represent an impedance of about 7 ohms.

Another tapping can then be added with an additional 1.6×26, or 42 turns which will make available further impedances of 18 ohms and 45 ohms (using round figures). This brings the total number of turns up to 68. If we now add a further 1.6×68, or 110 turns, we shall extend the available impedances up to include 120 and 300 ohms.

Thus we have provided an impedance matching covering a range in excess of 300:1 with only five terminals. This is illustrated in *Fig.* 12. The actual numbers used of course can be made to suit the desired impedance range. The nominal impedances can be arranged to go from 2 to 600, in which case the arrangement would satisfactorily cover a range of impedances from 1 ohm to 1000 ohms without any serious mismatching.

Shielding

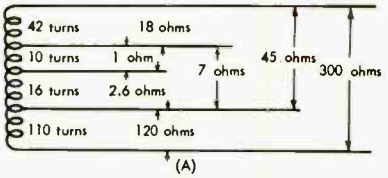
A final very important point in the design of input transformers concerns adequate shielding. Because these components are required to handle low-level signals, they will also be required to discriminate against the pickup of spurious signals. The most notorious form of stray pickup which input transformers can introduce is due to stray magnetic field. Protection against this can be provided by utilizing magnetic and electromagnetic shields to prevent the stray field from reaching the core of the transformer.

Just a word here on a factor that doesn't seem to be generally appreciated. The usual way of testing the effectiveness of shielding against magnetic field consists of placing the transformer, complete in its shielding system, in a calibrated field, which is provided by a loop of wire of specified number of turns, and usually 1 ft. square. The transformer under test is placed at the center of this square. The artificial field thus generated is practically uniform, due to the fact that the square is large compared to the dimensions of the shield and transformer under test.

Thus the value of discrimination against field determined by this test *holds only for a uniform magnetic field.* Unfortunately, many shielding arrangements do not give the same discrimination against stray pickup when the field is not uniform. And in practice, such as when the interfering field radiates from the core of a power transformer or smoothing choke, the field is *not* uniform. Measurements in a non-uniform kind of field are difficult to specify, but tests should be conducted, purely on a comparison basis, to see how much significance can be attached to the measurements according to the standard specification method.

It has been found, in some instances, that two transformers of different construction, which gave identical discrimi-

(*Continued on page 39*)



(A)

NOMINAL IMPEDANCE	RANGE COVERED
2 ohms	1 ohm to 3.2 ohms
5.2 ohms	3.2 ohms to 8.5 ohms
14 ohms	8.5 ohms to 22 ohms
36 ohms	22 ohms to 57 ohms
90 ohms	57 ohms to 150 ohms
240 ohms	150 ohms to 390 ohms
600 ohms	390 ohms to 1000 ohms

(B)

Fig. 12. Showing the multitapping method described in the text. At (A) the sequence of turns in the winding, and the combinations used for different impedances, on the assumption that 10 turns represents a nominal impedance of 1 ohm. At (B), showing how this arrangement provides continuous coverage for the range from 1 ohm to 1000 ohms, by using a sequence of nominal impedances starting at 2 ohms.

Transistor Bias Stabilization

PAUL PENFIELD, JR.*

A continuation of the MAY article on the same subject. Here a more complete chart of stability formulas is presented, with various approximate formulas.

PART I of this article described in simple terms how circuit design plays a large part in determining transistor bias stabilization. We saw that some circuit bias configurations were better than others in maintaining constant bias conditions. Temperature-induced variations in cut-off current can cause a change in collector current bias several times the cut-off current, unless precautions are taken in designing the bias circuit.

The bias stability factor, S, is equal to the ratio of a small change in collector current to the small change in cut-off current producing it. The lower the value of S, the more constant will be the transistor bias conditions, and therefore the higher quality will be the finished amplifier. Formulas for S were presented in a chart for a number of popular bias conditions, and the method of deriving the formulas was presented in sufficient detail to enable readers to work out for themselves unusual single-stage configurations which they may encounter.

Two assumptions were made which somewhat limited the scope of Part I: first, it was assumed that the transistor was kept in a region where the collector voltage had no effect whatever on the collector current, and secondly, it was assumed that the emitter current had no effect whatever upon the emitter-to-base voltage. These two assumptions simplified the derivation sufficiently that the resulting formulas were not unduly complicated. In most cases of practical interest, these two assumptions are sufficiently valid to preclude the necessity of deriving more complete formulas.

However there are three reasons why an investigation of the more complete bias stabilization formulas is of interest. First, it is more complete, and will apply in cases where the above simplifying assumptions induce errors large enough to be troublesome. Such instances may, for example, be in point-contact transistor amplifiers, or in amplifiers using special-purpose transistors, or where extreme accuracy is required. Secondly, computation of the complete formulas will enable us to determine just how much error *is* introduced by our simplifying assumptions, and can thus be used as a double check. And thirdly, the method of deriving the complete formulas applies better than the simplified method to two or more directly-coupled stages, where the stability problem may be considerably worse. Often it is advantageous to direct-couple transistor audio amplifiers, either to save the expense of a large coupling capacitor, or to save on space and weight.

The derivation of complete formulas for S proceeds from the transistor equivalent circuit shown in *Fig.* 6. This equivalent circuit uses three resistances, one associated with each lead, and an active element in the form of a current generator αi_e shunting the collector resistance R_c. Since α is defined as the short-circuit current gain,

$$\alpha = a + \frac{R_b}{R_b + R_e}(1 - a) \qquad (12)$$

or

$$a = \alpha - \frac{(1 - \alpha)\, R_b}{R_c} \qquad (13)$$

And since $R_b \ll R_e$ normally, $a \cong \alpha$. It should be stressed that this equivalent circuit is not the only possible one, but it is very widely used because engineers like to think intuitively of a resistance in series with each lead. However, the collector resistance, the emitter resistance, and the base resistance do *not* represent the lead resistance and bulk resistance of the germanium, but rather are incremental resistances due to *all* causes. Do not confuse the small-signal equivalent circuit shown in *Fig.* 6 with the structure of an actual transistor.

The equivalent circuit shown applies, strictly speaking, only at a given operating point. The parameters shown (α, R_e, R_b, and R_c) are themselves functions of the operating point, and because of this, this equivalent circuit (and any equivalent circuit) applies only at some stated operating point, at some given temperature.[2]

However, in our derivation here, we will assume that the parameters are constant over any operating range encountered. In a practical case, unless the stability factor S is very high, and a wide temperature range is encountered, or else unless the transistor drifts into saturation, the difference between the calculated and experimental bias changes will be completely insignificant. A discussion of the variation of the parameters with temperature and with operating point is outside the scope of this article.[3]

Before we start the actual derivation of the stability formulas, it is well to review briefly some points about the derivation last month. First of all, recall that we found that the actual position occupied by the bias batteries made no difference whatever in the values of S obtained. The value depended only on the resistances seen by the transistor. Again this is so, even considering our new equivalent circuit. We will take advantage of this fact again, and derive a complete formula for the general configuration shown in *Fig.* 7.

Secondly, we assumed previously that the collector current was independent of the collector voltage, and that the emitter voltage was independent of the emitter current. This corresponds to consid-

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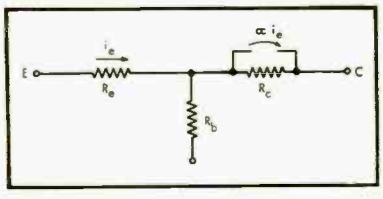

Fig. 6. Small-signal equivalent circuit for transistors, used in the derivation.

[2] This fact of course merely explains the importance of stabilizing the operating point well, for otherwise a temperature-induced change in operating point will significantly alter the performance of a transistor amplifier.

[3] See for example Chapter 2 of Shea, R. F., *Transistor Audio Amplifiers*, Wiley, New York, 1955.

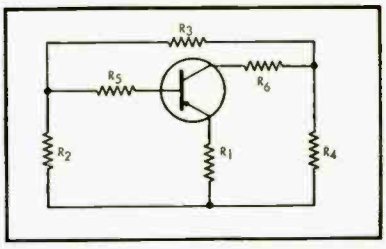

Fig. 7. A general bias diagram, which can be specialized into a number of practical circuits by appropriately selecting the resistance values and placing the voltage sources.

ering $R_c = \infty$, $R_b = 0$, and $R_e = 0$ in our new equivalent circuit, so the formulas obtained last month are merely approximate cases of the complete formulas we will derive here.

The Complete General Formula

The derivation of the complete general formula for the circuit of *Fig. 7*, using the small-signal equivalent circuit shown in *Fig. 6*, is quite complex. The circuit of *Fig. 8* illustrates the objective: that of determining the incremental ratio i_c/i_{co} in terms of the four transistor parameters R_c, R_b, R_e, and α, and the six circuit resistors R_1, R_2, R_3, R_4, R_5, and R_6. This particular bias configuration is used, because a large number of circuits of practical interest may be made by specializing the circuit values of resistance. $\left(\frac{R_c + R_b}{R_c} i_{co}\right)$ is used to be consistent with the convention that i_{co} is the short-circuit thermal current with the emitter open-circuited.

The actual derivation will not be given, since it is quite straightforward, but complicated and tiresome. No useful purpose would be served by consuming space for the derivation. The final answer—that is, the complete general formula for S—is also quite complicated:

$$S = \frac{(R_c + R_b)(A + B)}{(R_c + R_b) A + [R_b + R_1 + R_e + (R_c + R_b)(1 - \alpha)] B + R_3 R_4 (R_1 + R_2 + R_5 + R_e + R_b) + R_e R_5 (R_5 + R_b)} \qquad (14)$$

where

$$A = (R_1 + R_e)(R_2 + R_3 + R_4) + R_2 R_4 \qquad (15)$$

and

$$B = (R_3 + R_b)(R_2 + R_3 + R_4) + R_2 R_3 \qquad (16)$$

By letting $R_c = \infty$, $R_b = 0$, and $R_e = 0$, this cumbersome result reduces to

$$S \cong 1 + \frac{\alpha \left[\frac{R_3}{R_2}(R_2 + R_4) + R_3 + R_5\right]}{(1 - \alpha)\left[\frac{R_3}{R_2}(R_2 + R_4) + R_3 + R_5\right] + R_1 + R_4 + \frac{R_1}{R_e}(R_3 + R_4)} \qquad (17)$$

which is just the answer obtained when we made the assumptions mentioned. The exact formula (*14*) is quite long, and in practice the simpler formula (*17*) would be used whenever possible.

The general formula may be simplified considerably by considering special cases of practical interest. Table II is the result of doing this—the thirteen circuits shown in the table are obtained by specializing values of some of the resistances. The first nine are single-battery configurations, and the last four are two-battery cases. The complete formula for S, taking into account the transistor parameters, is presented in the table as formula i in each case. Formula ii is obtained by assuming $R_c \gg R_b$, and incorporating R_e and R_b into the external resistances R_1 and R_5 respectively, whenever these are not set equal to zero in the circuit.

Formula iii in each case is still more approximate—assuming that R_c is much larger than any of the other circuit resistors. Formula iv is made in each case by neglecting R_e and R_b when this has not already been done. This result is usually a fair approximation. Formula v, the least accurate, is made by neglecting the difference between α and 1, and is often quite a bad approximation. These last formulas are the simplest; however judgement and discretion should be used in employing them.

An Example

The circuit of *Fig. 9* was used in Part I as an example of how to determine the d.c. resistances, given a complete audio amplifier stage. The value for S we arrived at, assuming $\alpha = .95$, is 2.96. Now assuming not unusual values as follows: $R_c = 1$ meg, $R_b = 800$ *ohms*, and $R_e = 25$ *ohms*, we find that the new value for S is 3.24. (using formula i for circuit #2 in Table II).

If it were desired to find out how the d.c. bias changes from room temperature to 70° C, this is very easy. Let's assume that the room temperature cut-off current is 2.0 μa—not an unusual value. In that case, the cut-off current at 70° would be 45.2 μa, since the cut-off current rises exponentially with temperature, doubling every ten degrees C or so. With our calculated stability factor of 3.24, this means that the temtemperature-dependent collector current will amount to some 146 μa. If the transistor were originally biased at 0.2 ma. collector current, the rise due to temperature would be over half as much. The characteristics of the amplifier would change considerably due to the shift in bias conditions, since small-signal parameters change rapidly at low collector currents. For instance, if the transistor were driven from a source with 1000 ohms internal impedance, and loaded with 10,000 ohms, the power gain would drop more than three decibels due to changes in the transistor parameters brought about by the changed bias conditions.

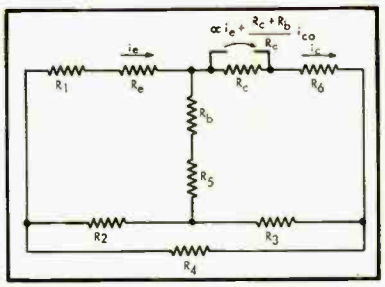

Fig. 8. Derivation of i_c/i_{co} proceeds from this diagram, which merely uses Fig. 6 circuit in the configuration of Fig. 7.

Often it is possible to control the bias stabilization in such a way that variations in parameters introduced by changes in operating point are somewhat counteracted by changes due directly to temperature. Other "tricks" available to one who builds wide-temperature-range amplifiers are too numerous to go into here—however the subject of bias stabilization is fundamental to all of this type of work.

Point-Contact Transistors

The formulas listed in Table II were derived for the case of a p-n-p junction transistor. However, they apply equally well to an n-p-n junction transistor, provided that the bias battery polarity is reversed. The various approximate formulas ii–v were made by making approximations expected to be valid for both types of junction transistors.

However, formula i in each case can

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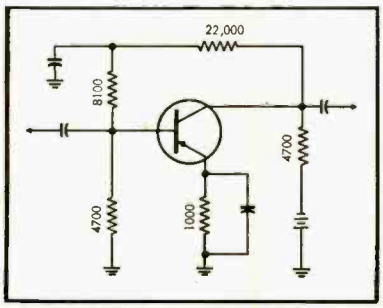

Fig. 9. A practical stage which can be put into the form of Circuit #2 of Table I for calculating S.

Room Environment

EDGAR M. VILLCHUR*

The final channel of a sound system is the room itself, which may have a profound effect on quality. The author discusses the problem of room acoustics, and what can be done about it.

Sound—Chapter 12

LIKE THE WEATHER, room acoustics is a subject which is talked about but seldom acted upon. There are, of course, many situations in which the builder of a sound reproducing system lacks either the power or the authority to take measures relative to the acoustical environment of the room (hi-fi wives being as they are—justifiably). But there are also principles that can be followed which, without turning things upside down, are able to improve significantly the performance of an installation in a given room.

Position of the Speaker System

If a speaker were mounted in an infinite, non-absorbent wall it would look out on half the universe. If it were placed at the junction of two such walls it would "see" only a quarter of the universe, and at the junction of three walls it would be restricted to servicing one-eighth of the universe. We refer to these conditions as the speaker seeing, or radiating into, a solid angle of 180 deg., 90 deg., and 45 deg., respectively.

The dimensions of a living room are not infinite, but the analogy to mounting a speaker system mid-wall, at the junction of floor and wall, and in a corner on the floor (or at the ceiling), should be evident. These three positions, in the order mentioned, progressively restrict the speaker's solid angle of radiation.

In the case of the infinite restricting surfaces it is obvious that when the solid angle is decreased the sound radiated by the speaker is concentrated, and a given amount of power will create higher sound pressures at a given distance from the source. In our room, however, the same cubic volume has to be filled with sound no matter where we place the speaker. We can properly ask, therefore, whether the solid angle of radiation makes a difference in room performance.

The answer is that it makes a profound difference. The reason lies in the fact that vibrating diaphragms do not normally radiate power uniformly in all directions, and that the nature of their directional pattern depends on the frequency of the sound being produced.

Any rigid vibrating surface will have a broader pattern of sound radiation as the frequency is lowered until, at a given frequency, it becomes essentially non-directive; that is, it radiates equally in any direction. (This occurs when the diameter of the radiating diaphragm is less than 1/3 of the wave-length of the sound.)

Let us take a loudspeaker system and place it in the middle of the floor, where the solid angle which it sees is maximum. The higher-frequency components will be concentrated in the area ahead of the speaker, while the bass will be diffused in all directions. The ratio of bass power to treble power, at a given listening position, will thus be affected; the speaker will show a loss of bass.

Now let us move the speaker back against the wall. The solid angle is reduced to 90 deg., and the sound density of the bass will be higher relative to the mid-range and treble. In a corner, on the floor, the relative amount of bass will be greatest. The bass is restricted to more or less the same angle of radiation as the mid-range and treble; it is not thinned out, as it would be if it were permitted to spread in all directions at the same time that the dispersion of higher-frequency components was restricted.

The differences in bass response which result from varying the mounting position of the speaker system may be greater than those which exist between different brands of speakers. The change from mid-wall to three-sided corner mounting will increase the relative bass power about four times (6 db). *Figure* 12-1 illustrates the difference in frequency response associated with four types of mounting position. The dotted line is for the speaker in the actual center of the room, on a pedestal or dangling by a rope. Here the loss of bass power, compared to that from a three-sided corner, is by a factor of 8, or 9 db.

What we have shown is that a corner mounting position, on the floor or at the ceiling, provides the fullest bass. This does not imply that such a mounting position is optimum for all rooms or for all speaker systems. A system (or room) that tends to be bass-heavy, for example, will be improved if the speaker is taken out of the corner, or raised off the floor. A floor position may also be less than optimum from the point of view of the treble; it is not normally desirable for the treble speaker to be low. Keeping the speaker enclosure cater-cornered, but several feet off the floor, is often an excellent compromise.

While this is the last chapter in the series, as the author indicates, his next-to-last chapter—the second part of the installment which appeared in the June issue and covered loudspeaker enclosures—will appear in the August issue. The subject will be "Horns." Ed.

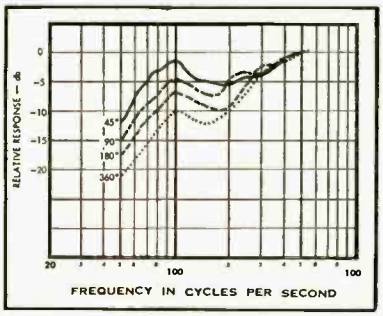

Fig. 12—1 Smoothed frequency response of a speaker system at four different solid angles of radiation. (a) Corner of room, on floor (45 deg); (b) junction of floor and mid-wall (90 deg); (c) mid-wall (180 deg); (d) suspended at center of room (360 deg). After Beranek.

Compensating for Speaker Placement

The changes in bass response—either attenuation or over-emphasis—associated with less than optimum speaker placement may be compensated in the amplifying system. The bass tone control in the amplifier may do some good, but if we examine the curves of *Fig.* 12-1 we will see that the "hinge" or transition frequency is about 200 cps, much lower than the transition frequency of most bass tone controls. Transition points between 500 and 1000 cps are typical of commercial bass control circuits.

A more accurate compensation for the variation in speaker placement is provided by a damping factor control on the power amplifier. Such a control acts effectively as a bass tone control which is

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hinged in the region of an octave or two above speaker resonance (the exact position depending on the values of DF used), and may thus be thought of as a compensator for different speaker mounting positions. Any adjustment of the damping control which secures flat bass response automatically secures optimum electrical damping at the same time.

The smaller the solid angle into which the speaker operates the higher the damping factor that is called for, and conversely, the larger the solid angle the lower the optimum value of DF, other conditions being the same. Thus, for a speaker at the junction between wall and floor, and for three-sided corners especially, the proper damping factor may normally be expected to be high in value. (Once the damping factor is as high as five there is little change produced by raising this value further. Increasing the DF to infinity could produce a maximum change in bass response of about 2 db; increasing the DF from 10 to infinity could produce a change of about 1 db). For larger solid angles, such as would be produced by mid-wall mounting, lower values of DF are called for, in some cases values of the order of one or less.[1]

The optimum value of damping factor is a function of the speaker used, the solid angle of radiation, and other conditions of the room environment. The best way to determine this optimum value, when damping control is available, is by trial and error. Using program material with a liberal low bass content, the damping factor is adjusted until the bass is most musically natural, neither over-heavy and boomy nor thin. Organ pedal tones, bowed and plucked bass viols, and bass drums provide good musical material for this adjustment.

The influence of the amplifier damping factor on speaker bass response is, however, severely limited in many cases. The influence is greatest where the speaker relies primarily on its electromagnetic system for damping (as do almost all direct-radiators), and is least when the damping provided by acoustical or mechanical means (such as effective horn-loading, damped bass-reflex ports, or mechanically damped suspension systems) is predominant. Amplifier damping is, of course, powerless to control the effects of room resonances.

[1] The range of damping factor values referred to here does not extend into the negative region.

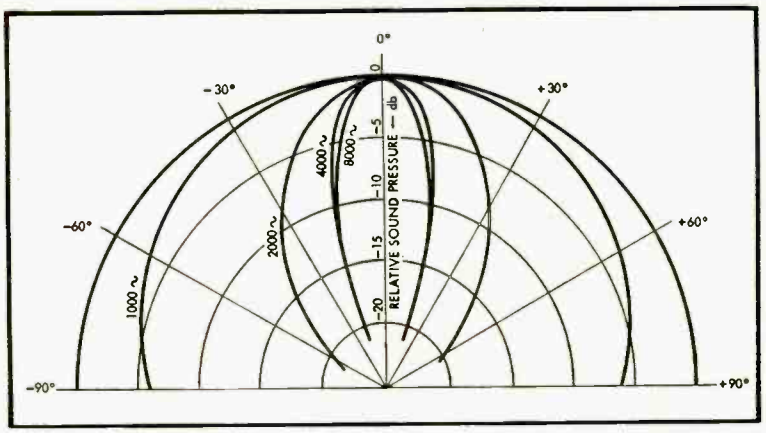

Fig. 12—2 Theoretical radiation pattern of 12-in. speaker (ignoring cone break-up) at different frequencies. A smaller speaker would have much better treble dispersion characteristics. (Courtesy Jensen Mfg. Co.—from Jensen Technical Monograph No. 1).

Room Liveness

A room is "live" when it is very reverberant; it is called dead when the reverberation is very much subdued. When one enters a room the sound of footsteps, conversation, etc., take on a characteristic quality,—a ring or a dullness associated with the acoustical environment of that room. The relative liveness of the room can also be tested roughly by listening to the sound of a sharp hand-clap, and noting the length of time required for the sound to die away. The longer the time the more reverberant the room.

The tonal balance of the output of an ideal reproducing system may be destroyed by a room which is too live or too dead acoustically. Dead rooms tend to over-absorb the higher frequencies (especially the mid-highs) relative to the bass, giving the sound a dull, muffled character. A room that is too live has the opposite effect, and may be conducive to overbright sound with an accentuated treble —the sound may even appear strident.

Smooth wood or plaster surfaces, bare walls and floors, etc., tend to create a live room, while drapes, rugs, overstuffed furniture and the like work to decrease liveness. The absorptive qualities of different materials commonly found in the home is listed in Table 12-1.

Once the room liveness has been established, and corrective measures applied as best they can be, the operator of a high-fidelity system has recourse to his tone controls and tweeter level controls. The neutral position for bass and treble tone controls may very well represent acoustical *im*balance in particular circumstances. Occasionally high fidelity enthusiasts have been misled to believe that, for the purist, the function of tone controls is public display in their neutral position. Actually, tone controls are a powerful means of getting the characteristics of the reproducing system and of the room to complement each other.

Treble Dispersion

It was pointed out in the beginning of the chapter that the nature of radiating surfaces is to restrict the dispersion of sound as the frequency increases. Since the higher the frequency the less diffuse the pattern, there is a tendency for speaker sound to confine itself to an increasingly narrow beam as the frequency goes up (see *Fig.* 12-2). Listeners sitting on-axis receive the full blast of the concentrated treble, while listeners seated off-axis tend to lose the treble portion of the spectrum.

This characteristic may be relieved in many ways, and high-fidelity speakers should have good dispersion patterns. Nevertheless it is difficult to avoid some narrowing in the treble, especially the

(*Continued on page 44*)

TABLE 12—1

Absorption coefficients of various materials commonly found in the home.

Material	Frequency, cps					
	128	256	512	1024	2048	4096
	Coefficient of Absorption					
Draperies hung srtaight, cotton fabric, 10 ounces/square yard, in contact with wall:	.04	.05	.11	.18	.30	.44
Draperies, velour, 18 ounces/square yard:	.05	.12	.35	.45	.40	.44
Velour draperies as above, 4" from wall:	.09	.33	.45	.52	.50	.44
.4" carpet on ⅛" felt on concrete:	.11	.14	.37	.43	.27	.27
.4" carpet on concrete:	.09	.08	.21	.26	.27	.37
Concrete, unpainted:	.01	.012	.016	.019	.023	.035
.5" plaster, lime on wood lath on wood studs, rough finish:	.039	.056	.061	.089	.054	.070
.5" plaster, gypsum:	.023	.039	.039	.052	.037	.035
Wood sheeting, pine, .8":	.10	.11	.10	.08	.08	.11

AUDIOCLINIC ??

JOSEPH GIOVANELLI*

Frequency Response

Q. In just about all the literature concerning tape recorders and amplifiers, I have seen references to the frequency response of the individual piece of equipment. As I have never seen an explanation of what this means, I would appreciate it if you would give me one. S. Weinman, Richmond Hill, New York

A. Sound waves are composed of vibrating air molecules. Some of the vibrations proceed at a comparatively slow rate; others are quite rapid. The number of vibrations occurring per second is what we call the frequency. In most of the equipment used for sound reproduction, these sound waves are converted into electrical voltages and currents which pulsate in accordance with the frequencies of the sound waves. In order that these electrical impulses may be translated back into sound, and at their original intensities, it is necessary that the amplifier (or other equipment) be able to pass all the frequencies with equal ease; if it cannot, some of the frequencies or ranges of frequencies will be emphasized or reduced in volume above or below the volume of the original sound, before its conversion into electrical impulses and back into sound waves again. When a piece of equipment does pass all frequencies with equal ease and efficiency, it is said to possess a flat frequency response. The response should deviate by not more than one or, at the most, two db if faithful reproduction is to be had. (For a further discussion of the decibel, see AUDIOCLINIC, April, 1956.) To measure frequency response, an audio-frequency oscillator is connected to the input of the piece of equipment to be tested. This device is capable of creating all the frequencies in the audio spectrum and somewhat beyond. The output of the piece of equipment being tested is fed into either an a.c. vacuum-tube voltmeter or an oscilloscope; either of these instruments will show whether or not the response is uniform. The voltmeter does this by means of a needle moving over the scale face; the more uniform the response, the less will be the motion of the needle. The oscilloscope shows the frequencies on a screen similar to that of a television set; the more uniform the response, the less will be the change in the size of the picture on the screen.

Yagi Antenna

Q. What is a Yagi antenna? M. Sherman, Sunland, Calif.

A. A Yagi is what is known as a parasitic array. In its simple form, it can consist of the main antenna (similar in theory to those with which you are already familiar), a reflector and a director. The main antenna element is what is called the driven element since it has electrical connection to the receiver or transmitter. The other elements are not electrically connected to the driven element. There may be more than one reflector or director in various combinations. Such antennas exhibit extremely directional characteristics. As the directivity of such an array increases, its sensitivity to signals coming to it from the proper direction also increases. They are quite critical to construct. If the spacing between the elements is inaccurate or if the length of any of the elements is incorrect, the Yagi will not perform satisfactorily. Without appropriate test equipment the construction of such an antenna should not be undertaken. It is only through the use of these instruments that optimum performance from the array can be realized. In the majority of cases, therefore, I recommend a pre-assembled unit. Several excellent Yagi antennas are commercially available for the FM band, 88–108 mc.

Preamplifier Design

Q. I wish to design a preamplifier whose output would be just sufficient to drive my power amplifier to full output when the volume control is set at maximum. Therefore, I should like to know what the maximum transverse velocity intentionally recorded on present-day micro-groove and 78 rpm recordings is. Wm. N. Tuller, Port Sulphur, La.

A. The average of maximum peak transverse velocities at 1000 cps is approximately 16 cm/second on a microgroove recording, although many records will be found with velocities up to 25 cm/sec. On a 78 rpm, the maximum peak transverse velocity is 22 cm/sec., also at 1000 cps. Knowing these velocities, the output voltage from the pickup you intend to use can be determined, since its output is stated by the manufacturer at a definite stylus velocity and frequency. One thing should be borne in mind, however, in designing such a preamplifier: for various reasons, some records never reach the maximum velocities as stated above. Under these circumstances, a power amplifier can never be driven to full output. This is not a serious problem if the power output of such an amplifier is high, say 50 watts. If the amplifier has a power output of say 5–10 watts, every ounce of output means a lot. Under these conditions, the records will not yield satisfactory performance. Therefore, a preamplifier can have considerably more gain than is actually needed, as it is better to have it and not need it than to need it and not have it.

Wow and Flutter Measurement

Q. What means is employed to measure wow and flutter? Frank C. Barney, Weir, Kansas.

A. Wow and flutter are measured with a device known as a fluttermeter. A test tape or disc is placed on the machine to be tested, depending upon whether it is a tape or disc player. It contains, usually a 3000-cps tone. The output of the player is connected to the input of the fluttermeter, which indicates wow or flutter directly in per cent. Wow and flutter cause the frequency of the test tone to change, the amount of such change above and/or below a nominal or test frequency being directly proportional to the amount of the speed variation. It can be said, therefore, that frequency modulation is taking place when wow and flutter occur.

Cathode Types

Q. What are the differences between a directly heated and an indirectly heated cathode? Eric Helgesson, Minneapolis, Minn.

A. A directly heated, or filamentary, cathode is one wherein the electrons are emitted by the filament itself or by a coating placed immediately on the filament. The material of which the filament is made in the first instance may be pure tungsten, used in high-power transmitting tubes, or thoriated tungsten, used in somewhat lower-power units. The coated filaments are used in many types of rectifier tubes, certain receiving tubes and special purpose tubes. It is for this reason that these filaments are of prime interest. Because the coating is sprayed directly on the filament and because the filament reaches operating temperature very quickly, these tubes require only a very short warm-up period, five seconds or less for most of them. As can be seen, the temperature of these filaments can change almost instantaneously. Thus, when a.c. is applied, the temperature can vary in accordance with the a.c. supply frequency, which will cause the electron stream to be modulated by that frequency, introducing hum into the tube's output. Another factor which tends to produce hum is the circumstance of the filament and cathode being the same. The a.c. voltage, when applied to this cathode, will modulate the grid bias, introducing still more hum. This last difficulty may be minimized through the use of a center-tapped filament transformer, the center-tap being used as the cathode connection for the cathode bias resistor. This, at least, causes a symmetrical variation above and below the center-tap, reducing hum probability by fifty per cent.

The indirectly heated, or unipotential, cathode is constructed as follows: the filament is insulated from the cathode by a ceramic material surrounding which is a metal sleeve coated with the emitting material. This material is the same as that used in the directly heated coated filament mentioned above, and is an alkaline earth oxide. In operation, the filament transmits heat by conduction and radiation to the emitting material. This takes some time, as seen by the comparatively long warm-up time of these tubes. The filament serves exclusively as a heating element. Thus, if the tube is in good condition, the variations in filament voltage caused by the use of a.c. will produce practically no variations in cathode temperature and will not modulate the bias circuit, minimizing the amount of hum introduced. However, when even these tubes are used in high-gain circuits, there is some danger of hum from the filament supply. It is therefore advisable to use d.c. on such filaments. These tubes do not have the power-handling capabilities of the directly heated types. However, in the uses for which they are suited, they are considerably more economical of filament power.

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

"Friction-Loaded" Enclosures—

Final Report

C. G. McPROUD

As discussed last month in the preliminary report on the "friction loaded" type of enclosure, our object was solely to explore the possibilities primarily to determine if the results bore out the theory offered by Jordan. Rather than attempt to work out the problem on a standard rectangular bass-reflex cabinet, we chose to experiment with one of the enclosures commercially available that we consider to be an excellent unit in itself —the Cabinart Rebel IV. In this cabinet, the port consists of a ½ × 26 in. slot which feeds a "horn" made by the sides of the cabinet and the two walls of the corner into which the unit is placed. This is in principle very similar to a cabinet described by the writer in 1949[1] in which the ports consist of two slits between the wings of the enclosure and the surrounding corner, the wings making an angle of 23 deg. with the walls. In both of these cabinets, the impedance curve rises quite sharply to a peak at a frequency somewhat below the usual resonance of the loudspeaker, with a second peak appearing somewhere between 80 and 120 cps, depending upon the size of the enclosure. Using the measuring circuit shown in *Fig.* 1, the impedance of the Goodmans Axiom 22 speaker in the Rebel IV enclosure measures as shown by curve A in *Fig.* 2. While the impedance curve is not necessarily a true picture of the acoustic output, it is a fair indication of the performance of the speaker. It will be noted that the lower peak is relatively high, and that it comes where the normal output of the speaker falls off. Thus there is excellent bass response, but with the smaller cabinet the second peak—shown at around 105 cps —can be heard, since it is in a range where the acoustic output of the speaker is greater, and where the ear is somewhat more sensitive. The theory indicates that the second peak can be depressed by increasing the over-all port area and providing acoustic resistance in the additional area.

Jordan suggested the use of long slits, but if they were spaced closely together, it was felt that the relatively narrow pieces of wood left between the slits might in themselves resonate and cause trouble. The same result, it would seem, could be obtained by providing the same additional area with many small holes. Accordingly, 175 holes were drilled on one of the sides, being laid out on 1-inch centers over a space 6 × 24 inches, using a #25 drill of a diameter of 0.1495 in. This increases the port area by only 3.05 sq. in., but this is not inappreciable considering the original port area of the cabinet is only 13 sq. in. Curve B in *Fig.* 2 shows the impedance curve the speaker with 175 holes. Note that the low resonant frequency has moved up about 2 cps, but that the upper peak is reduced in amplitude by about one half.

Since this appeared to be a step in the right direction, 175 more holes were drilled in the other side, with curve C representing the impedance of the speaker. Again the low-frequency peak has moved up by a few cycles, but the upper peak is practically gone. The listening quality, from a subjective standpoint, was improved noticeably, since the small amount of "boominess" due to the upper peak had disappeared. Further experimentation showed that by reducing the length of the original slit from 26 inches to 18, the low-frequency peak returned to its original point without disturbing the smoothing-out of the upper peak. The change was not noticeable to the ear, but it would seem to be better to have the low peak as far down the frequency scale as possible.

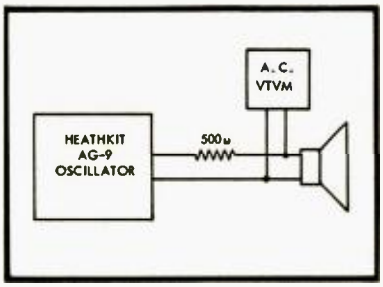

Fig. 1. Circuit used in measuring speaker impedance.

We feel that the treatment improved the performance sufficiently that there might be considerable advantage in applying the same treatment to any other bass-reflex cabinet, but it would be most desirable to have adequate equipment to make sure of the performance—although the ultimate aim of the loudspeaker and its cabinet is to please the ear rather than the instruments. But one cannot, in spite of this, overlook the need for controlled experimentation, particularly because it is possible with the instruments to know just how far to go, and just how much difference each step makes. For accurate measurement, it is necessary to use some sort of oscillator which will permit repeatable settings over the range from 10 to 100 cps, preferably with one-cycle increments. The Heathkit AG-9 is eminently suitable for measurements of this type, since it covers this range in steps of one cycle and is adjusted by two switches, one giving ten-cycle increments and one giving one-cycle steps.

For those who do not wish to go through the trouble of experimenting on a step-by-step basis, involving the removal of the cabinet back many times and taking run after run with oscillator and vacuum-tube voltmeter, similar results can be obtained with a commercially available device made by Goodmans Industries. This is the Acoustical Resistance Unit, which consists of a frame with an unrestricted small area and an additional area which is "friction loaded" with the correct amount of acoustical resistance. This unit is simply installed in an opening of a given size, with several such units being available for cabinets of different cubic content.

It is felt that the experimentation described has achieved two results—it has improved, in our opinion, an already-good enclosure and it has served to prove the claims made by Jordan. From these results, it would seem that many users of bass-reflex cabinets might well improve their performance by experimentation along these lines.

[1] "A new corner speaker design," Audio Engineering, January–February, 1949.

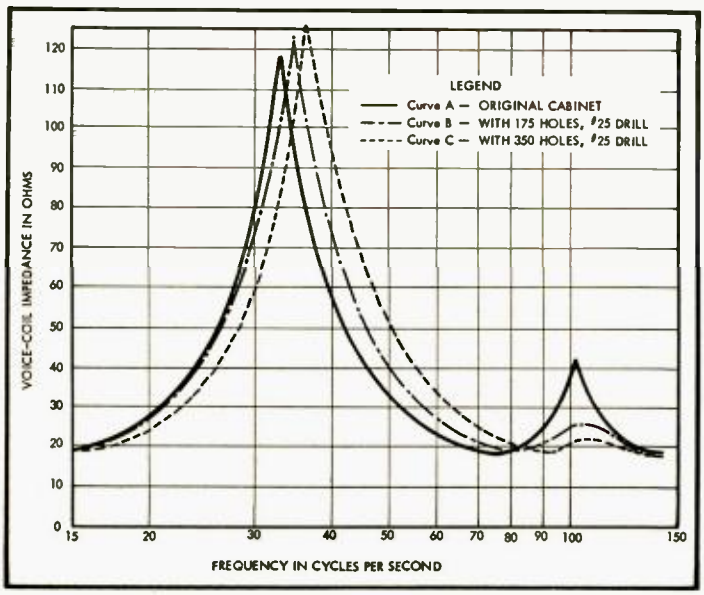

Fig. 2. Impedance curves of Axiom 22 speaker in Cabinart Rebel IV enclosure under three conditions.

ABOUT MUSIC

HAROLD LAWRENCE*

Music and Ideology (Part One)

THE DEATH OF STALIN and his plunge into Soviet purgatory brought forth a grisly parade of facts and suppositions regarding his personal life and political career. He was a paranoiac who trusted no one, least of all the very men who planned and fought in the Revolution, he ruled by whim and terror, his decimation of the ranks of the Red Army during the purges of the Thirties nearly brought about Russia's defeat in World War II, he was responsible for the Polish Underground's annihilation by triggering their premature uprising against the Nazis, he has been accused of having been a wife-killer, child torturer, and spy for the Czarist secret police.

With tears in his eyes, Khrushchev addressed the 20th Party Congress and listed some of these "crimes" and many others. What he failed to touch on was the effect of Stalin's dictatorship upon the arts and sciences. In the field of genetics, for example, Lysenko established, with the leader's approval, a Soviet-styled theory which had disastrous results on Russian agriculture and on research in general. When novelist Alexander Fadeyev joined the presidium of the Union of Soviet Writers, its head, Maxim Gorky, suddenly died, other famous authors disappeared, and lesser writers were openly arrested. Fadeyev, incidentally, was the one who made the classic remark about Western authors: "If hyenas could type and jackals could use fountain pens, they would produce such works." He was referring to the works of Eugene O'Neill, André Malraux, T. S. Eliot, and other "capitalist" figures. In the field of music, Stalin sent book-ripper Andrei Zhdanov to put to rights Soviet music. Under the latter's chairmanship, the Central Committee attacked the "false, vulgar, and sometimes pathological" output of the four most famous and honored composers of Russia: Prokofiev, Shostakovitch, Miaskovsky and Khatchaturian.

Stalin's body has not yet been removed from the mausoleum in Red Square, but there have been other changes. The closed fist has been replaced with the handshake in foreign policy, invitations have been extended and accepted for East-West visits, and there is even talk of sharing atomic information. To reassure the world of its good intentions, Russia's new collective leadership now admits past errors. The legal code has allegedly been revamped in order to prevent convictions based on confessions *per se*, concentration camps have supposedly been abolished, and many victims of Stalin purges have been "rehabilitated." Lysenko has been denounced, Fadeyev repudiated, and Molotov dropped from his high position. Books and plays that were banned under Stalin have emerged into the light. Yasienki's *The Plot of the Indifferent* has recently been published with an introduction by his widow who blames his arrest on "the slander of provocateurs," and a play that was suppressed twenty-seven years ago (its author, Meyerhold, died in a concentration camp) is now running to capacity audiences in two Moscow theaters and may soon be presented in the United States with either Alec Guiness or Michael Redgrave in the leading role.

How will the new government policy of relaxed controls affect Russian music? For one thing, the denunciation of the "cult of personlity" relieves Soviet composers of the unpleasant task of writing such works as *Toast to Stalin*, *Stalin Cantata*, *Lenin*, and *Kirov Is With Us*. Contact with foreign artists and compositions, e. g., Issac Stern and *Porgy and Bess*, will undoubtedly encourage a more international approach, that is, so long as a friendly face is turned to the West. Beyond that, the future is problematical. The zig-zag course of Soviet policy has seldom allowed any one program to flourish for more than a decade.

In 1918, on the eve of his departure for the United States, Serge Prokofiev was told by the People's Commisar of Education: "You are a revolutionary in music. We are revolutionaries in life. We ought to work together." Statements like this ushered in the first chapter in Soviet musical policy. The authorities had decided that all music writtten before 1917 was decadent. Accordingly, pieces like Mossolov's *Iron Foundry*, Honegger's *Pacific 231*, and Deshevov's *Rails* were hailed as symbolic of the "glorious new era," especially since they would help industrialize the nation.

In those days, the more radical the music, the better. The only difficulty was in finding enough modern music to play. This proved an insurmountable obstacle, what with the lack of funds with which to purchase foreign scores, and the public's "reactionary" bias in favor of the classics. The ideologists were forced to capitulate. As a result, Wagner, Tchaikovsky, Brahms, Mendelssohn, and other products of the degenerate past were tolerated. Government spokesmen, however, continued to attack "bourgeois" music, singling out for praise the "true revolutionaries" of the past: Beethoven, Moussorgsky, and Berlioz (who actually packed a pistol in the 1830 Paris Revolution).

The government's attitude came to its logical culmination in the founding of the Association of Proletarian Musicians, one of whose first acts was to oust the director of the Moscow Conservatory. The name "Conservatory" was changed because it bore the ugly connotation of "conservatism," and the institution became the Felix Kon Memorial School of Higher Music. The Association then set up a list of proscribed composers including Tchaikovsky: "parasitic spirit of Russian aristocracy," Chopin: "drawing-room esthete," Schumann: "antisocial ultra-individualist," Bach: "churchman," and Rachmaninoff; "émigré, White Guard bandit" (Juri Jelagin: *The Taming of the Arts*).

Proletarian music received its first setback at the hands of none other than Joseph Stalin who, in the early days of the first Five Year Plan, reportedly dropped the remark that Tchaikovsky's *Queen of Spades* was his favorite opera. The opinion was taken up by the press and soon no one had to apologize for playing bourgeois music or even music from "enemy capitalist nations." It therefore came as no surprise when, in April 1932, a government decree abolished the Association of Proletarian Musicians.

"Life is Better, Life is Gayer," was Stalin's slogan during this period. Light music was encouraged and jazz bands, now officially approved, delighted Russian audiences. The accent on joy, however, had its shortcomings. Conductor Heinz Unger, one the first foreign artists to visit Russia after the Revolution, had once been asked by Kharkhov's music directors to reverse the order of the last two movements in Tchaikovsky's *Pathétique* Symphony, playing the fourth third, and the third as the finale. "We can't possibly allow," they argued, "a concert to end with such a destructive and pessimistic slow movement as the lamentable fourth one of this symphony. So we think it better to play it before the third." Needless to say, Unger performed it in the right order, but the authorities effected a compromise: the work came at the beginning instead of at the end of the program.

The years 1932–1936 represented a period of relative freedom from government supervision. Then, in 1936, the party stepped in again with editorials in *Pravda* aimed at Shostakovitch and at modern music in general. The attack subsided after a few months but was to reappear a dozen years later with even greater impact. (*Music in Russia, from 1936 to the present, will be reviewed in the next issue.*)

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COMING EVENTS

Aug. 21–24—WESCON. I.R.E. Convention and West Coast Electronic Manufacturers Association show. Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 22–Sept. 1—National Radio Show, Earls Court, London, England. For information, write Andrew Reid, 11, Garrick Street, London W.C. 2.

September 27–30—New York High Fidelity Show, New York Trade Show Building, New York. Presented by Institute of High Fidelity Manufacturers, Inc., with participation of Audio Engineering Society.

September 27–30—Eighth Annual Convention of the Audio Engineering Society, New York Trade Show Building, New York.

Oct. 1–3—National Electronic Conference, Chicago, Ill. For information, write J. S. Powers, Executive Secretary, 84 E. Randolph St., Chicago 1, Ill.

Oct. 4–7—New York Audio Fair, Hotel New Yorker, New York City.

Oct. 7–12—80th Convention, Society of Motion Picture and Television Engineers, Ambassador Hotel, Los Angeles, Calif.

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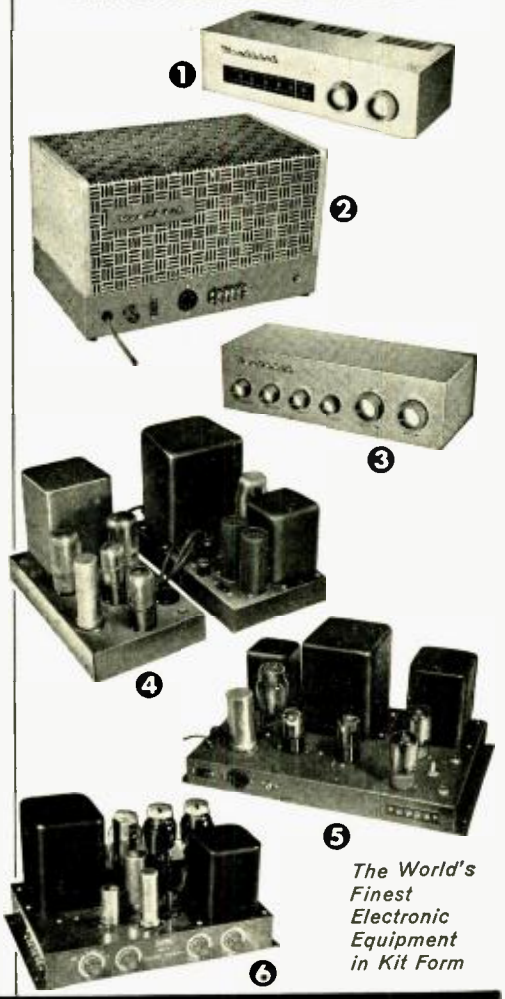

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EDWARD TATNALL CANBY*

1. FRENCH MUSIC

Ravel: Volses Nobles et Sentimentales; Ma Mere L'Oye (Mother Goose Suite); Menuet Antique. Orch. Nat. Radiodiff. Francaise, Cluytens. **Introd & Allegro.** Lily Laskine, harp, Pascal Quartet et al.

Angel 35173

A beautifully tailored recording of three Ravel orchestral works—all from piano originals—plus the early Introduction and Allegro for harp, string quartet, flute and clarinet. Recording is shiny, richly hi-fi, the all-French playing impeccably natural and sympathetic.

Mother Goose is well known in this orchestral version but the set of waltzes is most often heard in the piano original. This ballet setting of the music is florid, complex, the tempi stretched slower and faster, for more ballet contrast. It's a fine ballet piece, but if you know the waltzes themselves you'll still prefer the more straightforward—and more poignant—piano version. Altogether a lovely record, thoroughly tasteful from microphone to album cover.

Debussy: Le Mortyre de Soint Sébastien. Claudine Collart, Janine Collard, Christiane Gayraud, Cho. Radiodiff. Fr., Orch. du Th. Champs-Elysées, Inghelbrecht. André Falcon, narrator.

London-Ducretet-Thomson DTL 93040/41 (2)

A superbly exciting and revealing performance, bringing more of this last major Debussy work to our ears than in any previous version—for this one includes the extensive narration in French, and it proves to be not only exciting but the element that preserves the dramatic whole of an extraordinarily moving and tense work of emotional climax. The ghastly moment when Sebastien, martyred by the arrows of his own comrades, shouts in agony, "Encore, encore, encore"—more, more—is surely one of the most terrifying in all modern staged music.

The piece originally was presented elaborately as a kind of stage pageant, in the Swiss manner, with large chorus and solo voices, plus the narrator, who speaks long poetic and dramatic texts often interrupted by the chorus and solos. We've heard the bones of the music, the instrumental part only, as an orchestral suite that is now seen to be thoroughly truncated and misleading. London and others have released more complete versions including all the music—but lacking the narrator.

Those who own the narrator-less recordings owe it to themselves to acquire this version. It won't put the others out of business, since the music, both choral and solo, is lovely in itself, and admittedly is partly obscured in detail by the narrator's constant speech. But the overall dramatic continuity is positively breathtaking when the music falls into its proper place as highly charged commentary upon the words being spoken, the story that is unfolding. An unforgettable experience, this, and the recording is superbly done, the performance positively incandescent.

Ravel: Complete Piano Works. Gieseking.

Angel 3541 (2½)

A monumental piano collection, played by one of the greatest of French interpreters, that paradoxical exception-who-proves-the-rule, that Germans don't understand French music and vice versa, Walter Gieseking! The playing is of course masterful, so much so that many of the works will sound unaccountably easy and unshowy, so completely are their notes under the Gieseking fingers. Phrasing, dynamics, tempi, piano coloration, all are those of a superb master of the art.

Yet, oddly enough, it seems to me that, as one listens to piece after piece, there is an element missing here and consistently so. That is the controlled, often nearly hysterical fury, the razor-edge temperament that burnt white-hot under Ravel's faultlessly stylized exterior. In a strange way, Gieseking does not seem to be aware of it. The style is there, the whole polished beauty, but the explosive in it has been curiously toned down. Not to dullness—far from it. Gieseking could not play a dull or heavy note. But, especially in the later works where that frenized element became more and more pronounced, there is a curious lack of high tension. It shows most openly in the Valses Nobles et Sentimentales, which already suggest the intensity of that much later work, La Valse; it also shows this curious lack, in that furious late work, Gaspard de la Nuit.

This is not a criticism, in the purely negative sense, for Gieseking is too great a pianist not to have worked out his own interpretation of Ravel with superb musical consistency. It is simply an aspect to watch, to sense in the listening, and to compare with others' versions of the fiery and tasteful Ravel piano writing.

Piano recording is somewhat distant, as in other Gieselkings of this series, the piano sound on the soft side without unpleasant edge or percussion. Musically superb though hi-fi piano lovers probably won't think so much of it. Musicians will thoroughly approve.

Franck: String Quartet in D Major.

a) Loewenguth Quartet.

Epic LC 3227

b) Parrenin Quartet.

Westminster WL 18136

A curious comparison these two versions of Franck's only quartet make. Both are played by properly French performers, both are well recorded, both are done with high technical precision.

Yet oddly, the Parrenin group, four graduates of the French Conservatoire itself, and so perfectly matched in training and background, miss the spirit of the work most remarkably and, so to speak, interestingly. Their version plays the notes, expertly. It is musicianly, well balanced, technically just about flawless. But ten seconds of the Loewenguth recording will show any old Franckophile that there, the music (as the old saying goes) lives and breathes. It does not in the Parrenins' recording.

Could this be another manifestation of the current and rapid loss of the Romantic tradition on the part of our rising younger musicians? I would guess so. The Parrenins, playing their best, somehow make the Franck seem long winded, the harmonies old-fashioned, the spirit of mysticism not quite believable. The Ninth chords seem too ripe, the flights of lyricism, too naive. In a word, you are likely to say to yourself, along with the Parrenins—yes, the old man is pretty out-of-date these days, for all his sincerity.

But put on the Loewenguths and suddenly, the music soars again; the Symphony in D minor jumps to mind at once—for it was completed just before this quartet. The music is still long-winded (it always was) and old-fashioned, too; but now it is believable, the playing is wholeheartedly in tune with its emotions, the lyric ecstacy is back again with all its moving intensity—and we are once more able to project ourselves back into Cesar Franck's unique inner musical world, to take it for itself, simply and directly.

We haven't yet lost the ability to appreciate full Romantic music—when the performers themselves play it with emotional understanding.

Ravel: Sonata for Violin and Piano; Tzigane; Kaddisch; Piece en Forme de Habanera; Berceuse. Zino Francescatti, violin, Artur Balsam, piano.

Columbia ML 5058

Coolly intense performances of a group of Ravel works for piano and violin, the main item being the sonata of 1927 with its tinge of jazz blues and the 1924 Tzigane, gypsy-evoking. Somehow, these works could be more sensuously played than they are here, and perhaps a bit more sensuously recorded, too, with more space and liveness. This is hardly academic chamber music.

Roussel: Bacchus et Ariadne, Op. 43; Suites #1 and #2. Lamoureux Orch., Martinon. **Fauré: Pelleas et Mélisande, Op. 80. Debussy: Petite Suite, arr. Büsser.** Lamoureux Orch., Fournet.

Epic LC 3165

The Lamoureux orchestra, under two conductors, offers a good French program. Rousel is a somewhat unclassifiable semi-modern, a French Respighi, given to highly colored and highly complex scores, thickly orchestrated but with a modern hardness about them, notably in his works of the 1920s such as this ballet, Bacchus et Ariadne. I find the music pretty turgid though admittedly well written.

The other side is really more attractive musically. The familiar Fauré suite has here an extra movement not ordinarily played (and don't ask me why . . .); both it and the also-

* *780 Greenwich St., New York 14, N. Y.*

familiar early Debussy suite are played with much Romantic expression and plenty of light and shade. I'd say these are the best versions of the two works currently available.

Fauré: Piano Quartets #1 and #2. The Robert Masters Piano Quartet.
Westminster WN 18093

Here is some of the most durable and widely attractive music of the long-lived Fauré in excellent performances. The First Quartet (piano and three strings) is remarkably of the German school, close to Brahms and to Schumann, but already with a most agreeable lightness and a beginning taste of French harmonic color as leavening. The Second Quartet, from seven years later (1886), is already more suggestive of César Franck and the French mysticism that eventually grew into Impressionism.

Both works are solidly of the late-Romantic era, which means that they are emotional in outward expression and in no hurry at all to say what they have to say. A lot of music here for those who are used to conciseness!

Jean-Marie Leclair: Eight Sonatas for Flute and Continuo (harpsichord). Jean-Pierre Rampal, Robert Veyron-Lacroix.
Oiseau-Lyre OL 50050/51 (2)

Jean-Marie Leclair: Six Sonatas for Violin and Continuo (harps. and cello). Georges Alès, vl., Isabel Nef, hps. Pierre Codee, cello.
L'Oiseau-Lyre OL 50087/88 (2)

Marin Marais: Suites #1 and #2 for Two Viols and Continuo. Robt. Boulay, Marie-Thérèse Chailley-Guiard, violas, Laurence Boulay, Immgard Lechner, harps.
L'Oiseau-Lyre OL 50048

France under the great kings Louis had a truly remarkable musical tradition which is now coming out, for us, from under a too-heavy blanket of German and Italian music of the same period. The French music is recognizably of the same time—from the early 17th century to the Mid-Eighteenth—but it has an altogether different sense, a different and less monumental sort of melody, highly elaborated but also highly songful, and a structure quite the opposite of the grandiose architectural works of German music that culminated in Bach himself. Here are three pleasing documents-on-records to introduce you to this French music in and around the time of Bach.

Both composers (and numerous others as well) were full masters of their art. The Leclair flute sonatas are the most interesting group in this collection, with richly live and clear recording, and an equally rich playing on the flute. These are "Bach-like," but already with a considerable touch of the later *galant* gracefulness that led to Mozart and to Gluck. (Leclair had heard Quantz, the famous flutist of the court of Frederick the Great.

The Leclair violin sonatas are potentially even more effective, but the recording in this set is uneven, with an edgy metal to the violin and a certain confusion in the acoustic background that bespeaks of not-too-good mike placement. Plays best with some roll-off, or with the Old-LP (Old Columbia) equalization position. Alès is a somewhat lunging fiddler with a poor sense of phrasing for this music and Nef's harpsichord seems to have trouble in reaching an ensemble with him.

The cello, properly a matter of choice in any continuo accompaniment (for keyboard, only the bass notes, plus figures, being given) is heard in some of these sonatas, not in others.

Marin Marais is known for his viola da gamba music. These two exceptional suites were for two such instruments—or others to taste—plus continuo accompaniment. Violas here are a good choice. The music is broad and almost orchestral in effect, the rather muffled sound of the violas nicely reinforced from both top and bottom by the harpsichord's solid bass and sharp-edged treble.

Marin Marais: Five Old French Dances; Suite in D Minor.
Caix D'Hervelois: Two Suites. Paul Dok-

tor, viola, Fernando Valenti, harps.
Westminster WN 18088

This, unfortunately, is best classed as an encore disc, in spite of the music, which is as interesting as that above and, moreover, is legitimately played on the viola though written for the more cello-sized viola da gamba ("leg viol"). This performance is no more than good academic viola playing without a vestige of a sense for the period; it might just as well be Brahms or Kreiselr we are hearing. Very musical, but out of style, with a rich vibrato and much unctuous slowing-down.

As if to point all this up, Mr. Valenti's accomodating harpsichord, which should by rights be on a tonal equality, is placed discreetly in the background. Solo viola music and not much else.

Music at the King's Chapel. Jean Giraudeau, tenor; Marcel Dupré, organ, Ens. Marius Cosadesus et al.
Westminster XWN 18167

Consisting entirely of motets on Latin texts composed for the French chapels of the glorious Kings Louis of France, this disc might seem forbidding—but it isn't. The music is extraordinarily expressive and wonderfully consistent in style over a century of steady development, and the tenor soloist, Jean Girandeau is a consummate musician with a beautifully quiet and graceful voice of the French sort.

The King's music in its various chamber forms is now beginning to emerge for us, as we are able more and more to perform it in approximately its original form. It is useless in any other shape. In addition to the familiar names of Couperin and Rameau there now are new big names—Lalande, Marc-Antoine Charpentier—unknown to most of us before. This record introduces still others and the astonishing equality of value among these works, known or unknown, merely points out for us the high standards of style and content that were met by those who qualified as the King's musicians.

Like most music of the time, this has for our ears a peculiarly gentle, sweet sound, rather intimate and yet impersonal as well. Harmonies, rhythms, ornaments, phrase-lengths are all new and at first somewhat strange, until the gentle and compelling flow of the music takes over.

These are highly musical performances, though not perhaps fully knowledgeable from the musicological point of view. The ornaments seem to have been removed or simplified, the tempi seem occasionally out of style, the dotted-rhythm slow movements are, I would guess, played too literally. But the lovely quality of the tenor voice and the unusual tones of the old organ which Marcel Dupré plays are bewitching, musicology or no. A memorable record and a fine introduction to a new world of old music.

Milhaud: La Cheminée du Roi René; Suite d'après Corrette. French Wind Quintet.
Oiseau-Lyre 53002 (10")

Woodwind enthusiasts take note of this. The French are fanatically fond of woodwind music—flutes, clarinets, horns, oboes, bassoons, saxophones—and not only play them assidnously but write for them constantly. Here are two Milhaud contributions, brilliant trifles, tongue-in-cheek and thumb to nose, folksy but nevertheless well built and idiomatic as any French woodwind piece rightly is.

Audio ETC.

(from page 10)

feel that a Mozart symphony is a Mozart symphony however you may record it. But the fact remains that tape and disc are rather rapidly drawing apart, in a commercial way.

Discs continue to sell through the vast numbers of record stores, large and small, and (increasingly) by direct mail.

Tapes are finding new markets through

wholly separate outlets. Tapes sell in hi-fi stores, radio stores, music stores, even in appliance stores along with toasters, vacuum cleaners and electric ranges.

Records are distributed mainly through regular disc record distributors in the field, to the stores. Tapes are finding entirely new distribution, unconnected with disc records. Tapes will be distributed through hi-fi and appliance distributors, along with toasters and amplifiers.

All of which means that tape records now are reaching people who don't ordinarily get to record stores at all. Tape is making new markets for recorded music, among those who don't even buy disc records, or haven't, so far. Tape records, thanks to their novelty and hi-fi appeal, will sell all sorts of strange and wonderful music (classical especially) to people who would never get around to trying it at all in the disc form.

This is both wonderful and terrible. Wonderful in that music is being sold to new people, who wouldn't have touched it before. Terrible—for the moment—in that these new tape enthusiasts joyfully buy up the damndest pieces of classical music to use as mood stuff or background, and—for the moment—don't even know the difference. They swallow Bach or Mozart or Haydn with utter glee, simply because it's music on tape and tape is new! B. and M. and H. may turn in their graves and should; but in the end, surely no harm will be done. In the long run, the chances are good that B., M., & H. will sell themselves musically to these new listeners, on their own sweet merits.

So . . . in spite of duplication of material, we find that tape and disc are becoming quite separate fields. How about the third field, stereo?

4. Who'll handle Stereo?

At present, stereo tape is thought of as a deluxe and expensive alternative to "plain" tape. You can get so-and-so piece in the standard (monaural) tape or, for more cash, in the stereo version. This, you'll note, is the same sort of approach as we had at first to disc *vs.* tape. Two alternatives for the same sound, one fancier than the other.

But disc and standard tape actually *are* alternatives, from the same masters. Even so, they are finding different places in our hi-fi economy. Stereo tape and standard tape are *not* the same at all. Stereo is unique.

Therefore, inevitably, stereo must build itself as a separate, unique kind of recorded sound, not as a mere alternative kind of tape. The sooner this idea gets over to the public, the less confusion there will be.

Nobody knows exactly where the stereo audience lies, as of now. Is stereo to appeal to the present tape buyers—who buy mainly outside of record stores? Or is it to appeal to music lovers who buy music in record stores and music stores? A different set-up, a different distribution.

This is a crucial question and surely is making for some fierce headaches among those who are plunking for stereo right now. No doubt some companies who are already in tape distribution will sell stereo through their present set-ups, while those who are already distributing through disc channels will try to launch stereo that way. We'll probably get stereo both ways.

But the facts, long range, are as follows:

5. In the Foreground

Stereo tape and standard tape are inherently unalike. They cannot possibly play the same role in the future.

Standard tape is simply a new and dif-

ferent form of standard recording. Its present new market is based partly on better quality in the same music and partly on novelty. In effect, it opens up new uses for the same old product, the standard recorded sound, through new sales outlets, to new buyers.

But stereo tape is a basically different kind of recording with fundamentally different listening quality. Not completely different—nothing is ever completely new. But different enough so that it is not and will never be a mere quality alternative for the same old sound. It has its own, special, exclusive musical values.

And those values are of a sort that require *more careful* listening, *more* direct attention, not less, than standard tape or disc. Standard tape, on the other hand, is excellent for background or casual listening, or for hi-fi effects. It lends itself to the untutored ear.

Stereo recording brings out detail work in the music in a way that commands and requires attention. Stereo gives you more music—at the price of more listening.

Stereo is active, foreground music, in a way that standard recording can never be. It has no other reason for existing. Like TV, stereo requires a more conscious kind of attention, and gets it from you without difficulty. It grabs for your attention and keeps it—which is wonderful.

As we all know, people are often so ensnared by TV that they simply lose themselves in it, to the exclusion of all else. TV makes a very poor background medium and TV people know it. It's foreground. (Why else the double-length commercials! They've got your attention and they know it.) Radio, on the other hand, was fine for background. People turned it on and let it drone—they forgot all about it. They still do. They put other things in the foreground.

Stereo, in the same way, by its nature demands and gets your conscious attention. You must listen to it with your whole mind, and you will, in spite of yourself; you must also stay in the right listening spot—you can't wander around the house and expect stereo effects to follow after you. You will find that you must work at listening to stereo, and you will want to work.

If you listen to stereo sound merely as a background, if you move into another room, if you are off-center, out of the proper listening area, you will hear simply the old monaural music, and not very good monaural at that. You'll be paying more than double for the same old sound. Who wants to do that! And so, my friends, you'll listen to stereo in the foreground or you won't listen at all. That's common sense.

6. For Serious Listening

And so my final point and conclusion is that in the long run stereo belongs in the "serious" music category—serious of all types. Contrary to standard tape, it will be most useful where the listening is most foreward, most direct.

Stereo is clumsy and finicky. You have to fuss with it, you finagle around to find the best listening arrangement and you must stay put in one spot. You must work for your pleasure, and that's a fact. What sort of music is best, then, for a medium that is expensive, clumsy, but grabs your ear and makes attentive listening more rewarding than ever? Classical, I say. By Classical I mean all music designed for conscious, direct listening, and the term covers everything from Bach to modern jazz in my book. It does *not* include background music, whatever the sort.

Stereo, in other words, isn't for people

who like pushbuttons and who don't pay much attention to what they hear. It's for *listeners.*

And so all music that needs careful listening, all music to which you want to listen actively, music that has plenty to give for your attention, will benefit from stereo. The benefits, as I've found to my pleasure, are in proportion to the extra values of the music. The more stuff it has, the more whopping is the stereo punch.

And the more involved the score, the more complex the musical thought—the more solid will be stereo value. Particularly wonderful are the works of Bach, of Bartok, of Palestrina, of Richard Strauss, where the textures and the ideas are thick and concentrated. Stereo sorts them out and throws them at you with extraordinary new clarity and musical effectiveness. The realism, you see, is basically a *musical* realism, a more effective musical projection. That aspect is more significant than the mere minor stereo improvement in spatial effect which has been so loudly hailed. More of this later.

* * * * *

Yes, stereo will at first make its biggest hit as a hi-fi novelty. It has already, to some extent. Hi-fi sound effects—from the jet planes and the whooshing locomotives to the noisy blasts of the "1812" Overture—will be in the stereo forefront. Indeed, most of the initial sales explosion will center about these more obvious stunts in sound.

But I offer a fair warning to salesmen and a warning to music listeners too. Don't forget that stereo has a longer-range, more permanent value for fine music. Don't forget that *the more complex the music (the more highbrow, if you will), the greater is the stereo improvement, for the intelligent listener.* Stereo is not just another kind of hi-fi gadgetry, however much that way it may seem to you, sometimes, right now.

If this seems a rather sudden conversion on my part—it is, on the basis of new evidence. I was ever so dimly enthusiastic, three or four years ago, about "loudspeaker binaural," now properly called stereo. What was being done then was hardly convincing, nor could I do much on my own to convince myself. I didn't have any orchestras to play with. Other people did and the results, after much serious experimenting and lots of real progress, are now at hand in the tapes already released and on the market. I'll review a batch of them in the next issue, as a follow-up to this article.

While you're at it, look at a piece by R. D. Darrell in the June issue of our neighboring magazine, *High Fidelity*, where Mr. Darrell starts a new column, The Tape Deck. He, too, has been converted to stereo and for reasons not unlike my own. (And thanks to our editor for passing on this plug for a worthy colleague.)

Nobody expects stereo tape to replace standard disc recording. To worry about that would be absurd, both for the record dealer and the record buyer. Stereo is a specialized, tricky, expensive medium requiring special equipment and, more important, needing rather special listening conditions. The results, as I say, can be remarkable, but this doesn't mean that we can't get as much as ever out of the more convenient and much less demanding standard recordings (tape and disc), which can be set up and listened to any old way, background, foreground or sideground.

But stereo tape is here to stay and if you are a serious music listener you should keep it in mind as an adjunct to your regular record collection, if and when you can afford it. There's plenty of time.

NEW PRODUCTS

• **High-Output Audio Oscillator.** Precise attenuation, broad frequency coverage, compact size and low price are features of the new Model 210C audio oscillator recently introduced by Hewlett-Packard Company, 275 Page Mill Road, Palo Alto, Calif. Output of the instrument is 3 watts or 42.5 volts into 600 ohms. Frequency range is 20 to 20,000 cps in three bands

with calibration accuracy of ±1 per cent, frequency stability of ±2 per cent or 0.2 cps, and full-range frequency response of ±1 db. Distortion is less than 1 per cent at full output. An output attenuator lowers the output 40 db in 10-db steps. Hum voltage is less than 0.03 per cent of output. Complete information will be mailed on request **L-1**

• **Stromberg-Carlson FM-AM Receiver.** Headlining the new "Custom Four Hundred" high-fidelity components and cabinetry which will be available for fall delivery is the Model 406 FM-AM receiver, a single chassis which embodies a wide-range tuner, preamplifier, and 20-watt power amplifier. Tuner sensitivity is 5

microvolts for 30 db quieting. Spurious radiation is well within FCC requirements. Amplifier frequency range is 30 to 20,000 cps. Inputs are afforded for microphone, crystal pickup, magnetic pickup and auxiliary devices. Special output jack is included for a tape recorder. Bass and treble controls permit 15 db boost and cut at 50 and 10,000 cps, respectively. Other equipment in the new Stromberg-Carlson line includes tuners, preamplifiers, speakers, and enclosures to meet virtually every hi-fi requirement and budget. A unique style note will be introduced for all the amplifiers in the line in the form of a bonded-to-metal vinyl case, finished in mellow tan flecked with brown. The linen-like finish is guaranteed against mars, burns, scratches or stains. Stromberg-Carlson Division of General Dynamics Corporation, Rochester 3, N. Y. **L-2**

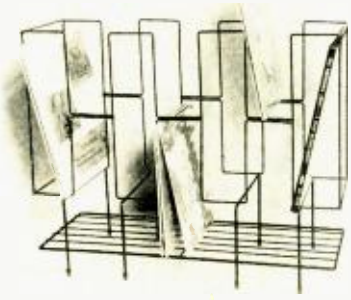
• **Monarch Record Changer.** Among advanced features of the British-made BSR Monarch 3-speed record changer is the "Magidisk," a single-knob control for handling all of the changer's functions. A sensitive feeler mechanism permits intermixing of 7-, 10-, and 12-in. records of the

same speed, and a ruggedly constructed 4-pole motor minimizes wow and hum. A sturdy metal tone arm accepts cartridges of every type. Functional modern styling of the Monarch is enhanced by a rubber-matted recessed turntable. The compact instrument measures only 12⅝ × 10¾ ins. Distributed in the United States by Discus Corporation, 225 W. 34th St., New York City, N. Y. **L-3**

• **Record Cleaner.** The Dual Micro record cleaner is a compact device made of molded plastic which cleans both sides of a record simultaneously. Inner (cleaning) surfaces

of the unit are lined with plastic foam. Records are cleaned in the direction of the grooves. In use, the stud of the Micro is placed in the center hole of the record and the record is revolved several times between two plastic foam surfaces. The Micro may be used with records of all standard sizes. United Audio Products, 202 E 19th St., New York 3, N. Y. **L-4**

• **Record Rack.** Virtually every feature which could be desired in a storage rack for records is inherent in the Model 274 manufactured by Leslie Creations, P. O. Box 9516, Philadelphia 49, Pa. Total capacity is 200 records. There are ten separate compartments, each accommodating up to



twenty 10- or 12-in. discs including jackets. Over-all dimensions are 25" long, 22" high and 10" deep. Constructed of welded steel rod, the rack is finished in black satin lacquer with matching vinyl plastic tips. Discs are supported vertically to prevent warpage. Inquiries should be addressed to Dept. 393. **L-5**

• **Electrostatic Tweeter.** Smooth response from 5000 to 20,000 cps and full 360-degree horizontal radiation pattern are among the advantages of the Pampa Model 5-20 electrostatic tweeter. Intended primarily for use with standard speakers to extend the frequency range of high fidelity music systems, the Pampa tweeter obtains polarizing voltage from the plate supply of the

amplifier. The polarizing lead from the tweeter is terminated with an octal tube adapter which is placed under one of the output tubes. Dimensions of the 5-20 are 4½" × 4½" × 12". A built-in crossover network is contained in the hand-rubbed wooden cabinet which is available in either mahogany or blonde finish. Pampa Electronics Corp., 7354 Frankford Ave., Philadelphia 36, Pa. **L-6**

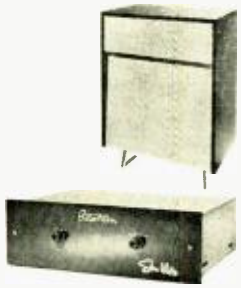
• **New Console for Kit Organ.** Designed by Richard H. Dorf for use with Schober Electronic Organ kits, this new console gives the feeling of a traditional organ case but has the smooth modern lines required for present-day living rooms. Handmade by custom furniture craftsmen, the console, with pedals and bench, contains first-grade solid wood and lumber-core veneer. Walnut is standard finish, but any other may be had. The console is

designed to accommodate the standard Schober kits, which may be assembled at home even by constructors with no previous electronic or musical experience to make up a full concert organ with 19 stops, 6 couplers, and normal American Guild of Organists dimensions and playing facilities. The tone colors available in the finished instrument are widely varied, including diapasons, flutes, strings, and reeds, and are extraordinarily lifelike duplications of pipes and orchestral instruments. All parts of the organ except power amplifier and speaker system are contained within the console which, with pedals and bench, takes up a floor area only 55 × 40 inches—little more than a small spinet piano. Full information on the organ kits and console may be had from The Schober Organ Corp., 2248 Broadway, New York 24, N. Y. **L-7**

HARVEY Reports on HI-FI

July-August, 1956

That's right! This is something new — a hi-fi newsletter by HARVEY's . . . the store where 'high fidelity came of age'. . . the store best qualified to talk hi-fi to all seekers of authoritative information on the subject. From now on we shall regularly report to you — in our own words, just as though we were facing you in our new AUDIOtorium — the latest developments in the world of hi-fi, with a few remarks thrown in now and then on older, tried-and-true equipment. This month all of the equipment under discussion is more or less in the de luxe category — but every item shares the distinction of unexpectedly low price for the quality offered.



Perhaps the most exciting news is the Stan White 'Summer Special' — a HARVEY package offering the famous Stan White 'Hi-Fi' speaker system (S339.50) *plus* the revolutionary new Stan White 'Beta-Tron' motional-feedback tweeter/amplifier system (S139.00) for the unheard-of package price of S299.50! You save S179.00 — if you act fast! The 'Beta-Tron' system consists of a ten-watt, 1,000-to-200,000-cps amplifier driving a specially designed 5-inch cone tweeter, with feedback going from a motion-sensing coil, located in the tweeter itself, back to an early stage of the amplifier. Thus, for the first time, a speaker unit is *inside* the feedback loop, the distortion-correcting signal being actuated by the voice-coil motion itself. The amplifier incorporates a 2,000-cps, 18 db/octave electronic crossover network, so that the system is ready for use with a conventional amplifier driving any speaker having good response up to 3,000 cps. In the 'Summer Special,' the older tweeter of the Stan White 'Hi-Fi' is removed and the 'Beta-Tron' tweeter installed in its place. Nothing like it . . .

You may have noticed that David Hafler's new **DYNAKIT** Mark II 50-watt power amplifier kit is drawing extravagant praise from all quarters — from the severest, eyes-glued-to-the-'scope electronic perfectionists as well as from the "ear-is-the-final-judge" boys. Small wonder, because for the ridiculous sum of $69.75 plus an entertaining three- or four-hour bout with the soldering iron you can have for yourself the power amplifier of your dreams — ready to take on all comers as far as frequency response, distortion characteristics, power handling capacity at any audio frequency up to rated power, phase shift, square wave response or anything else is concerned. Not a trace of bounce, flutter or oscillation after the severest transient pulses, either . . .

Speaking of amplifiers, the **Acoustical QUAD II** with the Q.C. II control unit, now in its third year on the market, still keeps cropping up in the news with reassuring regularity. After G. A. Briggs' fantastic results with it in his American concert hall demonstrations, we hear of it again as the amplifier P. J. Walker uses in England to demonstrate his epoch-making new all-electrostatic speaker. For the new reduced price of S199.95 the combination gives you the stablest, most silky-smooth 30 watts you can ask for . . . spectacularly versatile pre-amplification, controls, filters, and other front-end niceties . . . extra-low background noise . . . battleship-like construction . . . gorgeous, British-type wiring . . . plus styling of quiet elegance. For the fussiest audio connoisseurs . . .

Another consistent headline-maker is the **Ampex 612-SS** dual-channel stereophonic tape system. All who have heard it, including hard-bitten professional audio writers, seem to agree that the feeling of open space it puts around the music when it plays the new stereo tapes cannot be duplicated on single-channel systems in any price range. Just $699.00 will buy the complete outfit, with 7½ ips tape phonograph (playback only) plus two independent amplifier/speaker systems — ready to play, nothing else to buy. Will play conventional half-track and full-track tapes, too . . .

A new arrival just before press time: the **Tandberg Model 3** three-speed, half-track tape recorder and playback unit — and we are finding it a little difficult to believe our eyes and ears. Let the specs speak: Frequency response ±2 db from 30 to 15,000 cps at 7½ ips; +2 db from 40 to 7,500 cps at 3¾ ips; ±2 db from 50 to 4,000 cps at 1⅞ ips. Flutter and wow below 0.1% at 7½ ips and low enough at 1⅞ ips to be inaudible on piano recordings. Signal-to-noise ratio 60 db at high recording levels. Has been done before? Sure — but has it ever been done for $349.50, complete with built-in amplifier, Goodmans speaker, transport case, microphone, input-output cord, instruction manual and a reel of tape?

In conclusion, just a reminder that ordering by mail from HARVEY's is one of the most pleasant and convenient ways to do your hi-fi shopping. No downtown traffic to buck, no hunting for hard-to-get items (HARVEY's has 'em *in stock*), plus HARVEY's 29 years' reputation, pre-testing service and money-back guarantee to back every sale. Your order filled the same day we receive it, too . . . Just add a generous allowance for postage (you'll get the excess back with the package) and wait for the postman with the armful of listening pleasure.

HARVEY RADIO CO., INC. 1123 Avenue of the Americas (6th Ave. at 43rd St.), New York 36, N.Y. JUdson 2-1500

Be Your Own Record Critic

THE WINNERS

First place: C. D. Rife, 102 Piedmont Rd., Oak Ridge, Tenn.
Second place: Bert Eberius, Box 206, Monsey, N. Y.
Third place: Don Sasman, 821 E. Mulberry St., Lancaster, Ohio.

All will receive records of their choice for their interest and cooperation.

Mr. Rife gave a concise and well expressed description of the Alfred Deller record, and because he has at least indicated that there are various traditions of folk song performance associated with some of these songs, the Deller style being of one special sort. His review precedes Mr. Canby's.

Mr. Eberius has an interesting comment on the recording technique, the liveness used along with the voice. (Some others thought this an especially good feature.) Mr. Sasman offered a peppy commentary, which makes good reading and expresses strong convictions, even if you may not agree with him.

BE YOUR OWN RECORD CRITIC

Choice of LP records for three best reviews sent in each month.

Simple as that! Just write your own review on the record selected by Mr. Canby for the "Problem of the Month," send it in, and perhaps yours will be one of the fortunate three chosen by the judges. If your review is first, you may select any three records reviewed in this issue; if yours is second, you may select two; the third choice may select any one record. Your selections will be shipped to you postpaid at no cost to you.

Each month, Mr. Canby will name one record as the "Problem of the Month." Listen to it, study it both as to music and as to recording quality. Then write a brief review on a postcard—no other entries will be considered—and send it to AUDIO, Dept. RR, P. O. Box 629, Mineola, N. Y. so that it arrives on or before Aug. 6, 1956. Winners will be announced in the September issue, and the review chosen as first will be published, along with Mr. Canby's own review, in the same issue.

For this month's problem, Mr. Canby has selected:

The Siena Pianoforte. Turina, Albeniz, Villa-Lobos, Mompou. Maria Regules. Esoteric ESP 3002

Buy it, borrow it, or just listen to it somewhere—then tell us what you think about it.

RULES

1. Decisions of the judges are final and no correspondence will be entered into regarding entries or choices of the judges.
2. Reviews of the selected record must be submitted on a government postcard. No others will be considered.
3. Only one entry will be considered from each contestant.
4. All entries are to become the property of Radio Magazines, Inc., and the one chosen as first will be published.
5. From the list of records reviewed by Mr. Canby in the issue in which the "problem record" is announced, the writer of the review chosen as first will be given three records of his choice; the writer of the review chosen as second will be given two records of his choice; the writer of the review chosen as third will be given one record of his choice.
6. Entries will be judged on the basis of both musical and technical accuracy. Neatness and form will not count, but the reviews must, in the opinion of the judges, be sufficiently legible to be read easily.

CANBY REVIEW

The Three Ravens. Songs of Folk and Minstrelsy Out of Elizabethan England. Alfred Deller, counter-tenor, Desmond Dupre, guitar and lute.
Vanguard VRS 479

"The Three Ravens" commands respect because of Alfred Deller's artistry and because of the splendid recording Vanguard has given us. With all respect to Mr. Deller, however, this collection is not completely satisfactory, primarily because many of the songs included simply sound better as performed by other types of voices. Undoubtedly some of the selections were sung by counter-tenors during Elizabethan times, but audiences today are more accustomed to hearing "Barbara Allen," for instance, sung by a folk singer with a guitar. On the other hand, such selections as the "Coventry Carol" come off beautifully, with Mr. Deller's voice lending a haunting, eerie quality eminently suitable to the song. I'd recommend this to counter-tenor enthusiasts and to broad-minded "balladomanes." The two lute solos by Desmond Dupre are sheerest delight..

—C. D. Rife

Mr. Canby's review:

The immediate appeal—if it is that—of this disc is the high alto male voice. It it surely unusual at first. But already many of us have become accustomed to the counter tenor voice as such, after numerous recent recordings. It has a potentially very strong appeal as a musical instrument—as every age but ours has always known. The novelty is subsiding, but the music, the musicianship, remains, and on this score Alfred Deller is always interesting to hear.

This record represents the old British tradition of "folk singing," applied also to the singing of many old traditional songs such as "Drink to Me Only" which are often actually composed songs and/or were sung mainly in sophisticated circles, not by country yokels.

The British singer of this sort (and his American counterpart) sings the music as art-song, with a trained-voice style, usually with a sophisticated piano or other accompaniment—not at all of the yokel sort. Some of these settings were composed in the olden days; some are new. The guitar, here, would seem to be a recognition of the new trend to "authentic" folk stuff, as of the U.S., but it doesn't really affect Mr. Deller's approach, which is very far removed from the rough-and-ready styles of folk singing—as sung by the country people themselves.

Make this distinction in your mind—and you can go on to Mr. Deller's own singing, which is, within this style, of exceptional beauty. You can't beat your foot to it and the whole thing is a bit aetherial—but the voice is hauntingly beautiful, the pitch unusually sensitive. And Mr. Dupre's lute (or guitar) is excellent, in the tradition.

Note that the real minstrels of old were sophisticated, educated singers who sang to the upper classes, generally. Hence the modern use of minstrelsy as indicating an art-song approach to music much of which was originally sung in this citified, non-folksy fashion, as opposed to the "authentic" folk music styles. Two very different approaches, but both have their values. And songs like "Barbara Allen" have a flexible enough history to have appeared in the 16th century in the fancier musical circles, yet also to exist in dozens of primitively folkish versions in the Southern Mountains of the U.S.

—Edward Tatnall Canby

INPUT TRANSFORMER

(*from page 19*)

nation against the specified test field, give very different performance under practical conditions. Although practical conditions of required hum rejection are difficult to specify, this is what the user wants, so some effort should be expended to see that the transformer shielding gives a really good performance under practical conditions, as well as complying with a given specification under standard test conditions.

Another kind of stray pickup can be transferred through the transformer from primary to secondary by capacitance transfer instead of direct induction. If the primary winding is designed to match a very low impedance, the normal signal voltages on this winding may be of very low order, less than a millivolt possibly. At the same time stray pickup on the low-impedance circuit, if it is not grounded, may well amount to several volts. This means that the discrimination of the transformer between signal in the accepted mode, from one side of the primary winding to the other, as compared with capacitance pickup on both sides together, must be in the region of 120 db or more.

This is an extremely stringent requirement and necessitates more than a simple electrostatic shield between the windings. The electrostatic shield may serve quite well in shunting away the static pickup in the primary without allowing the voltages to be transferred directly to the secondary. But unfortunately the static shield itself is also wound around the same core as the other winding, although it only consists of a single turn. And this is where care is necessary with such static shielding in an input transformer.

Stray capacitance transfer will take place between all points of the input winding and the static shield. These minute transfer currents will be taken to ground from the ground point on the static shield. If these minute currents produce a resultant rotational current around the core in this effective one turn, then there will be a resultant magnetization of the core due to this static pickup. This will get transferred to the secondary in the normal manner of electromagnetic induction.

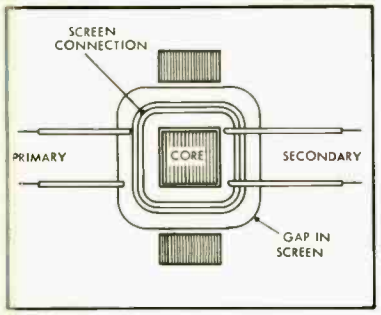


Fig. 13. A section through an input transformer with a single "static" screen, showing how the connection to the screen should be diametrically opposite to the point where the gap is.

The only way to eliminate this kind of transfer is to ensure that the resultant current in the shield, considered as a turn around the core, is completely neutral so as not to induce any magnetization of the core. This means that the static shield must be completely balanced with respect to the primary, as considered from the point where its ground connection is made. This is illustrated in *Fig.* 13. If even greater rejection of static pickup is required it may be necessary to employ two static shields as shown at *Fig.* 14. In each case the winding should be completely wrapped in its own shield and the balance preserved between winding and shield and between the two shields. Also the core should be separately connected to ground so as to preserve complete balance of stray current due to static pickup at all points.

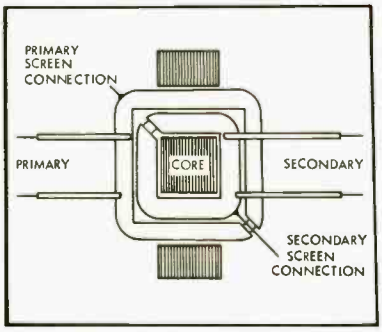


Fig. 14. The construction of a transformer employing a double "static" screen. Each winding should be completely enclosed in its own screen, except for the gap, and the gaps and connection points should be opposite as shown.

A-M TUNER CONVERSION

(*from page 16*)

boards. With the special board, wiring time was only ten minutes.

The only real work involved in the conversion involves the addition of pickup coil *L* to the last i. f. transformer. As pictured, simply slip the i.f. can up and off without disturbing the existing wiring. Next, make a coil form from gummed brown paper *slightly* larger than the plate coil of the transformer.

After estimating the number of turns on the plate winding (count the number of layers and multiply by the turns per layer) jumble wind an equal number—a ball-park guess will do—of turns on the paper coil form. Preferably, the winding should be Litz wire wound in two pies. Belden 8817 wire, available at

24¢ a spool, is satisfactory. Finish the winding by coating the form and coil with coil dope or speaker cement. When the dope has hardened, push the coil over the plate winding. If it is loose, use additional dope to hold it in place.

The above procedure can not be followed exactly for the older trimmer-tuned transformers. For these units, the coil L must be wound directly on the existing plate winding. It is still advisable, nevertheless, to use a layer of heavy paper to insulate the two windings from each other.

A supply of 12 to 20 volts is necessary for the collector circuit. This voltage is conveniently available across the cathode bias resistor of the amplifier output stage. *Figure* 1(A) shows how the voltage can be taken from the circuit. This is suitable for most beam-power tubes. For the Williamson circuit add an additional 1000-ohm resistor across the 50-μf capacitor as shown in dotted lines.

Operation

The trimmer capacitor or tuning slug for the plate i.f. winding will need readjustment for maximum signal strength. Do this readjusting while tuned to a very weak station.

Next, tune in a very strong station and measure the voltage across R_3 using a 20,000 ohm/volt or VTVM meter. This measured voltage must be less than one half the collector supply voltage. If it is greater than one half, increase the value of R_1 until a proper reading is obtained.

If the receiver has no r.f. stage, we strongly recommend that the original antenna coil or loop antenna be replaced with one of the new ferrite loopsticks. Also, it is advisable to add a 0.1-μf 200-volt capacitor from the a.v.c. end of the coil or loopstick to ground. This

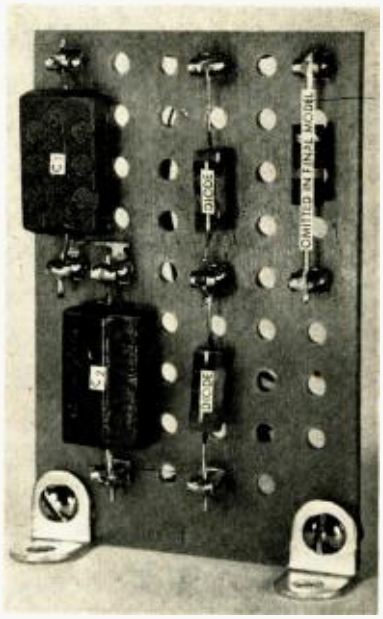


Fig. 4. Detector is wired on terminal board. The connecting jumpers and one capacitor are on rear of panel and not visible.

eliminates any tendency for the receiver to pick up hum in the antenna circuit.

Should 10-kc adjacent-channel interference be objectionable, a filter such as the Miller EL 58 may be added between the detector and audio amplifier or, even better, between the transistor emitter and junction of C_3 and R_3.

We have been very pleased with our modified radio as an AM tuner. Stations broadcasting good music are received from distances greater than 600 miles bringing good music to a community offering nothing on the local stations but the twangs and laments of a maladjusted hillbilly.

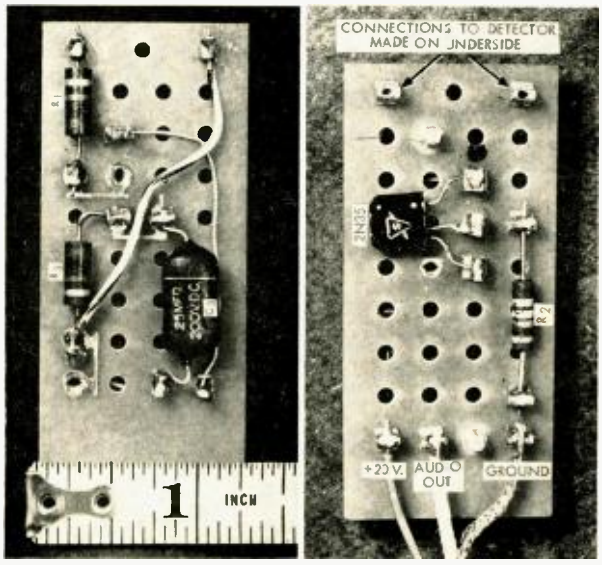


Fig. 5. Front and rear views of transistor terminal board.

TRANSISTOR BIAS

(*from page 21*)

apply equally well to any present type of transistor — point-contact, junction, hook, p-n-i-p, surface-barrier, etc. The only assumption involved is that the device be representable by the form of *Fig.* 6, and that the cut-off current originate in the collector lead. The fact that α is generally less than one in a junction transistor means that S in each case will be positive. This indicates a certain type of stability—namely that it is possible to maintain biases at any point.

Point-contact transistors (and hook transistors as well) generally have α greater than one, so it is possible to obtain values of S equal to infinity or negative. Such a situation is one in which no useful bias may be maintained—the least little bit of thermally-generated current will produce enough collector current to push the transistor into a non-linear region (saturation) where no useful amplification occurs.

Note that if α is greater than one by a sufficient amount, a high value of R_s will produce an unstable bias condition (See Formula i, Circuit 1, Table II). This is consistent with the widely-known method for producing oscillation from a point-contact transistor of using a high resistance in series with the base lead.

Direct-Coupled Amplifiers

It was mentioned earlier that adequate stabilization of d.c. amplifiers is considerably harder than that of a.c. amplifiers, since an increase in collector current of one stage cannot be separated from a bona fide signal input by the succeeding stages, and so it gets amplified right along with the signal. Since direct coupling is often used in transistor audio amplifiers, the subject is not at all out of place here.

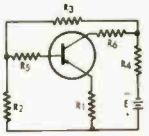
Normally, if a number of stages are direct-coupled, only the effect of the cutoff current of the first stage upon the collector current in the last stage will be important. Exceptions may arise, for example, if the gain of succeeding stages is not very great, or if transistors earlier than the final stage are extra-sensitive to bias changes, or if the second transistor has considerably more cut-off current than the first stage. However, these exceptional cases can be treated in a fashion similar to that given here.

In computing the effect of the first stage cut-off current on the final stage collector current, we define a composite stability factor S' which is merely equal to di_c/di_{co}, where i_c is the last stage collector current, and i_{co} is the first stage cut-off current. Computing S' here is quite simple, and consists of two separate computations. First, the initial stage

TABLE I

Circuits of popular bias configurations and progressively less accurate formulas for the stability factor, S.

1. GENERAL ONE-BATTERY CONFIGURATION



i. $$S = \frac{(R_c + R_b)(A + B)}{(R_c + R_6)A + [R_6 + R_1 + R_a + (R_c + R_b)(1 - \alpha)]B + R_3R_4(R_1 + R_2 + R_5 + R_a + R_b) + R_2R_4(R_5 + R_b)}$$
where $A = (R_1 + R_a)(R_2 + R_3 + R_4) + R_2R_4$
and $B = (R_5 + R_b)(R_2 + R_3 + R_4) + R_2R_3$

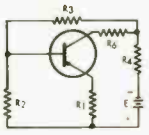
ii. $$S \cong \frac{R_c(A + B)}{R_c[A + B(1 - \alpha)] + R_6(A + B) + R_1B + R_3R_4(R_1 + R_2 + R_5) + R_2R_4R_5}$$
where $A = R_1(R_2 + R_3 + R_4) + R_2R_4$
and $B = R_5(R_2 + R_3 + R_4) + R_2R_3$

iii. $$S \cong \frac{R_1 + R_4 + R_3 + R_5 + \left(\frac{R_3 + R_4}{R_2}\right)(R_1 + R_5)}{(1 - \alpha)\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right] + R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$$

iv. $$S \cong 1 + \frac{\alpha\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right]}{(1 - \alpha)\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right] + R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$$

v. $$S \cong 1 + \frac{\frac{R_5}{R_2}(R_3 + R_4) + R_5 + R_3}{\frac{R_1}{R_2}(R_3 + R_4) + R_1 + R_4}$$

2. R_5 EQUALS 0.



i. $$S = \frac{(R_c + R_b)(A + B)}{(R_c + R_6)A + [R_6 + R_1 + R_a + (R_c + R_b)(1 - \alpha)]B + R_3R_4(R_1 + R_2 + R_a + R_b) + R_2R_4R_b}$$
where $A = (R_1 + R_a)(R_2 + R_3 + R_4) + R_2R_4$
and $B = (R_b)(R_2 + R_3 + R_4) + R_2R_3$

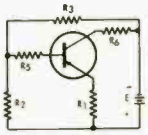
ii. $$S \cong \frac{R_c(A + B)}{R_c[A + B(1 - \alpha)] + R_6(A + B) + R_1B + R_3R_4(R_1 + R_2 + R_b)}$$
where $A = (R_1)(R_2 + R_3 + R_4) + R_2R_4$
and $B = (R_b)(R_2 + R_3 + R_4) + R_2R_3$

iii. $$S \cong \frac{\left(\frac{R_b + R_1}{R_2}\right)(R_3 + R_4) + R_1 + R_3 + R_4}{(1 - \alpha)\left[\frac{R_b}{R_2}(R_3 + R_4) + R_3\right] + R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$$

iv. $$S \cong 1 + \frac{\alpha R_3}{R_3(1 - \alpha) + R_1 + R_4 + (R_1/R_2)(R_3 + R_4)}$$

v. $$S \cong 1 + \frac{R_3}{R_1 + R_4 + (R_1/R_2)(R_3 + R_4)}$$

3. R_4 EQUALS 0.



i. $$S = \frac{(R_c + R_b)(A + B)}{(R_c + R_6)A + [R_6 + R_1 + R_a + (R_c + R_b)(1 - \alpha)]B}$$
where $A = (R_1 + R_a)(R_2 + R_3)$
and $B = (R_5 + R_b)(R_2 + R_3) + R_2R_3$

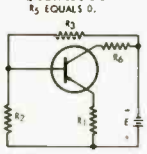
ii. $$S \cong \frac{R_c(A + B)}{R_c[A + B(1 - \alpha)] + R_6(A + B) + R_1B}$$
where $A = R_1(R_2 + R_3)$
and $B = R_5(R_2 + R_3) + R_2R_3$

iii. $$S \cong \frac{\left(\frac{R_2}{R_2}\right)(R_5 + R_1) + R_1 + R_3 + R_5}{(1 - \alpha)\left[\frac{R_5}{R_2}R_3 + R_5 + R_3\right] + R_1 + \frac{R_1R_3}{R_2}}$$

iv. $$S \cong 1 + \frac{\alpha\left[\frac{R_5R_3}{R_2} + R_5 + R_3\right]}{(1 - \alpha)\left[\frac{R_5R_3}{R_2} + R_5 + R_3\right] + R_1 + \frac{R_1R_3}{R_2}}$$

v. $$S \cong 1 + \frac{R_5 + \frac{R_2R_3}{R_2 + R_3}}{R_1}$$

4. R_4 EQUALS 0 and R_5 EQUALS 0.



i. $$S = \frac{(R_c + R_b)(A + B)}{(R_c + R_6)A + [R_1 + R_a + R_6 + (R_c + R_b)(1 - \alpha)]B}$$
where $A = (R_1 + R_a)(R_2 + R_3)$
and $B = R_b(R_2 + R_3) + R_2R_3$

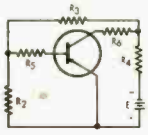
ii. $$S \cong \frac{R_c(R_1 + R_b + \frac{R_2R_3}{R_2 + R_3})}{(R_c + R_6)R_1 + (R_1 + R_6 + R_c(1 - \alpha))(R_b + \frac{R_2R_3}{R_2 + R_3})}$$

iii. $$S \cong \frac{R_1 + R_b + \left(\frac{R_2R_3}{R_2 + R_3}\right)}{(1 - \alpha)\left[R_b + \frac{R_2R_3}{R_2 + R_3}\right] + R_1}$$

iv. $$S \cong 1 + \frac{\alpha\left(\frac{R_2R_3}{R_2 + R_3}\right)}{(1 - \alpha)\left(\frac{R_2R_3}{R_2 + R_3}\right) + R_1}$$

v. $$S \cong 1 + \left(\frac{R_2R_3}{R_2 + R_3}\right)\left(\frac{1}{R_1}\right)$$

5. R_1 EQUALS 0.



i. $$S = \frac{(R_c + R_b)(A + B)}{(R_c + R_6)A + [R_6 + R_1 + R_a + (R_c + R_b)(1 - \alpha)]B + R_3R_4(R_2 + R_5 + R_a + R_b) + R_2R_4(R_5 + R_b)}$$
where $A = (R_a)(R_2 + R_3 + R_4) + R_2R_4$
and $B = (R_5 + R_b)(R_2 + R_3 + R_4) + R_2R_3$

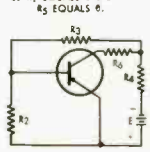
ii. $$S \cong \frac{R_c(A + B)}{R_c[A + B(1 - \alpha)] + R_6(A + B) + R_aB + R_3R_4(R_a + R_2 + R_5) + R_2R_4R_5}$$
where $A = R_a(R_2 + R_3 + R_4) + R_2R_4$
and $B = R_5(R_2 + R_3 + R_4) + R_2R_3$

iii. $$S \cong \frac{\left(\frac{R_3 + R_4}{R_2}\right)(R_5 + R_a) + R_a + R_3 + R_4 + R_5}{(1 - \alpha)\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right] + R_4 + R_a + \frac{R_a}{R_2}(R_3 + R_4)}$$

iv. $$S \cong 1 + \frac{\alpha\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right]}{(1 - \alpha)\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right] + R_4}$$

v. $$S \cong 1 + \frac{\left(\frac{R_5}{R_2}\right)(R_3 + R_4) + R_3 + R_5}{R_4}$$

6. R_1 EQUALS 0 and R_5 EQUALS 0.



i. $$S = \frac{(R_c + R_b)(A + B)}{(R_c + R_6)A + [R_6 + R_a + (R_c + R_b)(1 - \alpha)]B + R_3R_4(R_2 + R_a + R_b) + R_2R_4R_b}$$
where $A = R_a(R_2 + R_3 + R_4) + R_2R_4$
and $B = R_b(R_2 + R_3 + R_4) + R_2R_3$

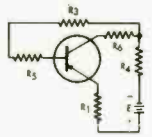
ii. $$S \cong \frac{R_c(A + B)}{R_c[A + B(1 - \alpha)] + R_6(A + B) + R_aB + R_3R_4(R_a + R_b + R_2)}$$
where $A = R_a(R_2 + R_3 + R_4) + R_2R_4$
and $B = R_b(R_2 + R_3 + R_4) + R_2R_3$

iii. $$S \cong \frac{\left(\frac{R_3 + R_4}{R_2}\right)(R_b + R_a) + R_3 + R_4 + R_a + R_b}{(1 - \alpha)\left[\frac{R_b}{R_2}(R_3 + R_4) + R_3 + R_b\right] + R_4 + R_a + \frac{R_a}{R_2}(R_3 + R_4)}$$

iv. $$S \cong 1 + \frac{\alpha R_3}{(1 - \alpha)(R_3) + R_4}$$

v. $$S \cong 1 + \frac{R_3}{R_4}$$

7. R_2 EQUALS ∞.



i. $S = \dfrac{(R_c + R_b)(R_1 + R_a + R_3 + R_4 + R_5 + R_6)}{(R_c + R_b)(R_1 + R_a + R_4) + [R_6 + (R_c + R_b)(1 - \alpha)](R_5 + R_b + R_3) + (R_1 + R_a + R_4)(R_5 + R_b + R_3)}$

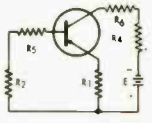
ii. $S \neq \dfrac{R_c(R_1 + R_3 + R_4 + R_5)}{(R_c + R_5 + R_3)(R_1 + R_4) + [R_6 + R_c(1 - \alpha)](R_5 + R_3)}$

iii. $S \neq \dfrac{R_1 + R_3 + R_4 + R_5}{(1 - \alpha)(R_5 + R_3) + R_1 + R_4}$

iv. $S \neq 1 + \dfrac{\alpha(R_3 + R_5)}{(1 - \alpha)(R_3 + R_5) + R_1 + R_4}$

v. $S \neq 1 + \dfrac{R_5 + R_3}{R_1 + R_4}$

8. R_3 EQUALS ∞.



i. $S = \dfrac{(R_c + R_b)(R_1 + R_2 + R_5 + R_a + R_b)}{(R_1 + R_a)(R_c + R_4 + R_b) + [R_4 + R_b + (R_c + R_b)(1 - \alpha)](R_5 + R_b + R_2) + (R_1 + R_a)(R_5 + R_b + R_2)}$

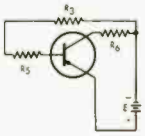
ii. $S \neq \dfrac{R_c(R_1 + R_2 + R_5)}{R_1(R_c + R_4 + R_6 + R_5 + R_2) + (R_5 + R_2)[R_6 + R_4 + (R_c + R_b)(1 - \alpha)]}$

iii. $S \neq \dfrac{(R_1 + R_2 + R_5)}{R_1 + (R_2 + R_5)(1 - \alpha)}$

iv. $S \neq 1 + \dfrac{\alpha(R_2 + R_5)}{(1 - \alpha)(R_2 + R_5) + R_1}$

v. $S \neq 1 + \dfrac{R_2 + R_5}{R_1}$

9. R_2 EQUALS ∞, and R_1 and R_4 EQUAL 0.



i. $S = \dfrac{(R_c + R_b)(R_a + R_b + R_3 + R_5)}{R_a(R_c + R_6) + [R_a + R_6 + (R_c + R_b)(1 - \alpha)](R_3 + R_5 + R_b)}$

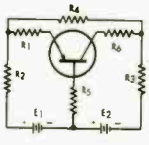
ii. $S \neq \dfrac{R_c(R_3 + R_5)}{[R_6 + R_c(1 - \alpha)](R_3 + R_5) + R_a(R_c + R_6 + R_5 + R_3)}$

iii. $S \neq \dfrac{(R_3 + R_5)}{(1 - \alpha)(R_3 + R_5) + R_a}$

iv. $S \neq \dfrac{1}{1 - \alpha}$

v. $S \neq \infty$. (Clearly in this case the approximation $\alpha = 1$ is not valid)

10. GENERAL TWO-BATTERY CONFIGURATION.



i. $S = \dfrac{(R_c + R_b)(A + B)}{(R_c + R_6)A + [R_6 + R_1 + R_a + (R_c + R_b)(1 - \alpha)]B + R_3R_4(R_1 + R_a + R_2 + R_5 + R_b) + R_2R_4(R_5 + R_b)}$

where $A = (R_1 + R_a)(R_2 + R_3 + R_4) + R_2R_4$
and $B = (R_5 + R_b)(R_2 + R_3 + R_4) + R_2R_3$

ii. $S \neq \dfrac{R_c(A + B)}{R_c[A + B(1 - \alpha)] + R_6(A + B) + R_1B + R_3R_4(R_1 + R_2 + R_5) + R_2R_4R_5}$

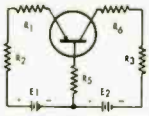
where $A = R_1(R_2 + R_3 + R_4) + R_2R_4$
and $B = R_5(R_2 + R_3 + R_4) + R_2R_3$

iii. $S \neq \dfrac{R_1 + R_4 + R_3 + R_5 + \left(\frac{R_3 + R_4}{R_2}\right)(R_1 + R_5)}{(1 - \alpha)\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right] + R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$

iv. $S \neq 1 + \dfrac{\alpha\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right]}{(1 - \alpha)\left[\frac{R_5}{R_2}(R_3 + R_4) + R_3 + R_5\right] + R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$

v. $S \neq 1 + \dfrac{\frac{R_5}{R_2}(R_3 + R_4) + R_5 + R_6}{\frac{R_1}{R_2}(R_3 + R_4) + R_1 + R_4}$

11. R_6 EQUALS ∞.



i. $S = \dfrac{(R_c + R_b)(R_1 + R_2 + R_a + R_b + R_5)}{(R_1 + R_2 + R_a)(R_c + R_4 + R_5) + [R_4 + R_5 + (R_c + R_b)(1 - \alpha)](R_5 + R_b) + (R_1 + R_a + R_2)(R_5 + R_b)}$

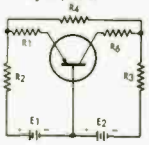
ii. $S \neq \dfrac{R_c(R_1 + R_2 + R_5)}{(R_1 + R_2)(R_5 + R_c + R_4 + R_3) + R_5[R_3 + R_4 + R_c(1 - \alpha)]}$

iii. $S \neq \dfrac{(R_1 + R_2 + R_5)}{R_5(1 - \alpha) + R_1 + R_2}$

iv. $S \neq 1 + \dfrac{\alpha R_5}{R_1 + R_2 + R_5(1 - \alpha)}$

v. $S \neq 1 + \dfrac{R_5}{R_1 + R_2}$

12. R_5 EQUALS 0.



i. $S = \dfrac{(R_c + R_b)(A + B)}{(R_c + R_b)(A) + [R_b + R_1 + R_a + (R_c + R_b)(1 - \alpha)]B + R_3R_4(R_1 + R_2 + R_a + R_b) + R_2R_4R_b}$

where $A = (R_1 + R_a)(R_2 + R_3 + R_4) + R_2R_4$
and $B = (R_b)(R_2 + R_3 + R_4) + R_2R_3$

ii. $S \neq \dfrac{R_c(A + B)}{R_c[A + B(1 - \alpha)] + R_b(A + B) + R_1B + R_3R_4(R_1 + R_2 + R_b)}$

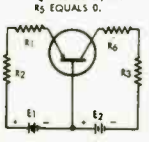
where $A = R_1(R_2 + R_3 + R_4) + R_2R_4$
and $B = R_b(R_2 + R_3 + R_4) + R_2R_3$

iii. $S \neq \dfrac{\left(\frac{R_b + R_1}{R_2}\right)(R_3 + R_4) + R_1 + R_3 + R_4}{(1 - \alpha)\left[\frac{R_b}{R_2}(R_3 + R_4) + R_3\right] + R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$

iv. $S \neq 1 + \dfrac{\alpha R_3}{R_3(1 - \alpha) + R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$

v. $S \neq 1 + \dfrac{R_3}{R_1 + R_4 + \frac{R_1}{R_2}(R_3 + R_4)}$

13. R_4 EQUALS ∞, and R_5 EQUALS 0.



i. $S = \dfrac{(R_b + R_c)(R_1 + R_2 + R_a + R_b)}{(R_1 + R_2 + R_a)(R_c + R_3 + R_b) + (R_3 + R_b)(R_c + R_b)(1 - \alpha)](R_b + R_b(R_1 + R_a + R_2)}$

ii. $S \neq \dfrac{R_c(R_1 + R_2 + R_b)}{(R_1 + R_2)(R_c + R_3 + R_b) + R_b[R_3 + R_b + R_c(1 - \alpha)]}$

iii. $S \neq \dfrac{R_1 + R_2 + R_b}{R_1 + R_2 + R_b(1 - \alpha)}$

iv. $S \geq 1$.

v. $S \neq 1$.

is separated from the second stage at some convenient point, and the *current gain* of the second, third, etc., stage, right up through the last stage, is determined. This should not be too difficult, since it will probably be known from the design of the amplifier. Actually, the ratio of the last-stage collector current to the second-stage input current is desired, but this is either equal to the amplifier current gain or can, at worst, be easily derived from it by inspection of the output stage coupling circuit. Next, the ratio of *output current* from the first stage to a change in cut-off current in the first stage is determined—again, either this is equal to the first stage stability factor S, or else can be derived from it easily. The product of these two factors, of course, is the value of S'. Because of the large number of possible d.c. amplifier circuits, there is no space for general formulas for multistage amplifiers. However, the derivation is not difficult in practical cases, and the reader should experience no difficulty. It should be remembered that the amplifier cannot tell changes in cut-off current from bona fide d.c. input signals, and thus the gain for the two will be the same.

If feedback is applied to a normal d.c. amplifier, the signal components and the unwanted changes due to cut-off current changes would be reduced by the same amount. However, a frequency-sensitive feedback arrangement may often be used in direct-coupled audio amplifiers to advantage, to reduce the d.c. gain, but not the a.c. gain. This is of course essentially what is done in *Fig.* 9 by the emitter by-pass capacitor, and the base bias shunting capacitor. However, this technique applied over several stages is sometimes very useful.

A discussion of other "tricks" in amplifier design is clearly out of the scope of this article. However, these few examples of practical applications of bias stabilization should suffice to prove to the reader that in this subject (as in most all facets of audio work) both formal training of the type offered in this article and imagination, flair, or "creative ability" are necessary. It is hoped that this article has managed to give the reader the tools he needs to cope with practical cases, and has successfully explained the problem of bias stabilization, and the methods commonly used to account for it and improve it.

ROOM ENVIRONMENT

(from page 23)

upper portion, and the speaker should be placed so that it commands the room well. The corner placement discussed previously with regard to bass also serves in this connection.

It would obviously be wrong, for example, to face a speaker away from the

major listening area and directly into a very absorptive surface, unless one meant purposely to tone down the treble. Treble dispersion may be improved, however, by placing the speaker so that the sound impinges upon reflecting surfaces, and is reflected back to the listening area in the desired diffuse condition.

Acoustical Resonances of Listening Room

The most annoying and difficult-to-deal-with characteristics of listening rooms are their resonances. The hand-clap test referred to can also be used to help detect room resonance—an echo which has a fairly distant musical pitch indicates a sharp resonance, and probably an unpleasant effect on reproduced music.

Not only is the reproduced sound accentuated at the frequencies of sharp room resonances, but the same "ringing" effect that followed the hand-clap influences the musical sound. The distinctness of orchestral or choral voices and the purity and accuracy of their tone colors is impaired or even ruined. The quality of such reproduction was well described by Shakespeare's monster Caliban, who complained:

"Sometimes a thousand twangling instruments will hum about mine ears. . . ." thus prophecying the era of high fidelity shows.

A room with sharp resonances may be expected to yield a boomy bass and an unclear treble. A reproducing system with smooth frequency response may sound as though it has a peaky and ragged curve. Furthermore this is the acoustical condition for which it is hardest to correct.

It is possible to experiment with placing absorptive surfaces in the room, particularly in such a way as to break up room patterns of regular geometry, as a method of counteracting acoustical resonance. The most practical way to deal with the problem, however, is to try different mounting positions for the speaker, a procedure which may force us to ignore the conclusions arrived at by consideration of the other factors referred to earlier.

The guidance principle is simple: if the sound has greater clarity, less unnatural reverberation in a particular position, that position is superior. Where more elaborate test facilities are available the system may be swept through the frequency spectrum, and the speaker mounting position which produces the least violent peaks and valleys is noted (the Fletcher-Munson psychological peak at about 3000 cps must be ignored).

The room is the final transmission channel in the sound reproducing system, and one of the most aberrant. Intelligent tailoring of the system to the room should thus play an important part in the successful installation of reproducing equipment.

NEW LITERATURE

• **Triad Transformer Corporation,** 4055 Redwood Ave., Venice, Calif., has just released the 1956 edition of its General Catalog. Illustrated and described are nearly 700 items, 76 of which are new to the Triad line. Copies of the new catalog, TR-56, are available from Triad jobbers, or may be obtained upon written request to the company. **L-13**

• **Magnetic Shield Division, Perfection Mica Company,** 20 N. Wacker Drive, Chicago 6, Ill., in Data Sheet 103 describes how to protect tape recordings from various high- and low-intensity magnetic fields by storing or carrying in Fernetic and Co-Netic protective cans. Also are listed dimensions and prices for rectangular cans, flat sheets, cylinders, transformer cans and instrument shields. Other data in the publication include terminology and example sheet from laboratory test reports on shielding high, medium, and low intensities. Available on request. **L-14**

• **Minnesota Mining and Manufacturing Co.,** 900 Fauquier St., St. Paul 6, Minn., is now distributing "Sound Talk" bulletin No. 32 which is devoted largely to a discussion of mechanical considerations in the use of thin-base magnetic recording tapes. The 4-page technical bulletin is illustrated with graphs and compares the physical properties of thin-base and standard-base tapes. Among the considerations covered are conformability to the recording head, acetate versus polyester films, inertia effect and guiding and winding. In addition, four major points in the use of thin-base tapes are summarized. Requests for copies should be directed to Dept. A6-141. **L-15**

• **Audio Devices, Inc.,** 444 Madison Ave., New York 20, N. Y., is issuing a new bulletin on Audiofilm, material made by the company for the original magnetic recording of motion picture and television sound tracks. Presented in the folder are some of the magnetic and performance characteristics of Audiofilm, also listings of sizes of film base, types of coating, and reels of various footages. Available free on request. **L-16**

• **General Radio Company,** 275 Massachusetts Ave., Cambridge 39, Mass., has published a worthy successor to its catalogs of the past in its new Catalog O. Possibly the most complete display of fine test instruments in the electronic industry, Catalog O may well be categorized as a service to the industry as well as a sales instrument for GR. Illustrations are handsome and text is lucid and complete. Catalog O is available to engineers, scientists, purchasing offices, and executives interested in the procurement of electronic measuring and test equipment. Requests must be on company or institution letterhead, and sent direct to General Radio Company.

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THE AUDIO EXCHANGE has the largest selection of new and fully guaranteed used equipment. Catalog of used equipment on request. Audio Exchange, Dept. AE, 159-19 Hillside Ave., Jamaica 32, N. Y. OL 8-0445; 367 Mamaroneck Ave., White Plains, N. Y. WH 8-3380
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RECORDED TAPE MUSIC, recording tape, accessories, discounts. Efsco Sales, 270-N Concord Avenue, West Hempstead, N. Y.

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SALE OR TRADE: Berlant BR-1 Recorder; want Ampex 600 or 612. Parrott, 2224 Beaumont St., Washington 21, D. C.

RECORD COLLECTORS—For sale, a 30-year collection of 78-rpm records—2800 records, all catalogued. Many rare ones. Write Theodore H. Adams, Middle Island R.F.D., L. I., N. Y.

Magnecord M90AC in portable cases. New condition, used less than 25 hours. $845 f.o.b. Dallas, Texas. Roland S. Bond, Jr., 2600 Republic National Bank Building, Dallas, Texas.

MAGNECORD, PT6-AII and PT-6 in portable cases. $335. Fine shape. Central Recording, 934 Kansas, Topeka, Kansas.

HI-FI CABINETS—Designers and sample makers. Production runs or custom. Ablewood Products, 133 Grand Street, New York, N. Y. CAnal 6-7846-7.

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PROFESSIONAL DIRECTORY

Industry Notes . . .

MRIA RE-ELECTS OFFICERS. The full slate of officers as proposed by the nominating committee under the chairmanship of J. Herbert Orr, president of ORRadio, was re-elected by unanimous vote at the recent annual meeting of the **Magnetic Recording Industry Association** in Chicago. Officers and directors elected to serve another term are: president, Joseph F. Hards of Magnetronics, Inc.; vice-president, Russell Tinkham of Ampex Corporation; secretary, Herman Kornbrodt of Audio Devices, Inc.; treasurer, Victor Machin of Shure Bros., Inc. The directors elected are Robert P. Leon of Brush Electronics, and Paul Jansen of Minnesota Mining and Manufacturing Company.

RECORDING COMPANY EXPANDS. Audio-Video Recording Company, Inc., New York, has acquired the former quarters of Station WMCA at 1657 Broadway, which will add eight studios to its operation. Renovation and modernization of the company's present studios at 730 Fifth Avenue, started last year, will be completed shortly. Installation of new technical facilities will commence immediately at both the Fifth Avenue and Broadway plants under the direction of Irving Kaufman, chief engineer.

AMPEREX ANNOUNCES NEW TITLES. Re-alignment of duties and titles for executives of **Amperex Electronic Corporation** has been announced by Frank Randall, national sales manager. Executives and their new titles are: Myron Smoller, manager of advertising and sales promotion; Arnold Peterson, distributor sales manager; Sol Gertzis, chief applications engineer; Charles Roddy, product manager for industrial tube division; Irwin Rudich, product manager in charge of semiconductors and special purpose tubes; Frank Agresti, technical sales engineer; Walter Sandberg, government contracts administrator, and Frank Elliot, sales office manager.

EXHIBITORS FLOCKING TO NEW YORK HI-FI SHOW. More than 90 exhibit rooms have been engaged by manufacturers of audio equipment who will participate in the **New York High Fidelity Show** this Fall. Scheduled for September 27-30 in the New York Trade Show Building, the show is the first audio exhibit in Manhatian to be sponsored by the **Institute of High Fidelity Manufacturers.** Although a majority of high fidelity manufacturers have already engaged exhibit space, there is still a number of desirable rooms available which will be allotted on a first-come first-served basis, according to Sanford L. Cahn, executive secretary of the IHFM.

PERSONNEL NOTES. Lawrence (Larry) LeKashman, audio-radio pioneer who was associated with Radio Magazines, Inc. as editor of CQ, and who for the past several years has been vice-president of Electro-Voice, Inc., Buchanan, Mich., returned to his home base of New York on July 1 as vice-president in charge of sales for David Bogen Company, Inc. . . . **Jack Fields,** since 1942 in partnership as a factory representative with Samuel S. Egert under the firm name Egert and Fields, New York, is organizing his own organization known as the Jack Fields Sales Company with offices in Verona, N. J. He will service high-fidelity and radio parts jobbers in the metropolitan New York and New Jersey area.

Clifford Rumsey, Ridgewood, N. J., sales executive, receiving commendation from both friends and competitors on the crack job he is doing in introducing Permoflux "Scribe" dictating equipment to industrial plants in Northern New Jersey . . . **Bryce Haynes,** vice-president of Audio Devices, Inc., makers of Audiotape and Audiodiscs, due to return any day from an extended tour of the company's European markets.

ADVERTISING INDEX

SIMPLE AS A B C

To make it just as easy as possible for AUDIO's readers to subscribe, order books, get further information about the new products and the new literature mentioned in the pages of the magazine, or to get catalog sheets and brochures describing articles advertised, we provide herewith three cards. We know that many readers are loath to cut coupons from the pages of their favorite magazine because they have told us so. And we know that many times one would like to have complete and thorough data about something he sees in these pages, yet he considers it too much trouble to hunt up paper and envelope—not to mention the stamp—and write a long letter detailing what he wants to know. This is just as simple as we know how to make it with the exception of stenciling each subscriber's name and address on each of the postcards—an operation which would be highly impractical from the printing standpoint. But from now on, when you want more information about something you have seen advertised or mentioned in AUDIO you need only indicate it on the appropriate card, print your name and address, and drop it in the nearest postbox. We pay the postage, and it goes without saying that we wouldn't include these cards if we didn't welcome your use of them. And, for the first time, you can enter your subscription without sending a penny with your order—we'll bill you later. For books, we'll have to ask for the money in advance, but only for books.

Readers have told us that they often want to know more about some of the items mentioned in the *New Products* and *New Literature* pages of the magazine, but that they do not want to take the time and effort to write to each one of the sources individually to get all the information they need. As a matter of fact, in an average issue there are usually ten items in the *New Literature* column, and between ten and fifteen on the *New Products* pages. It is conceivable that the average reader might want information on at least ten of these items, since they are selected with the interests of most of AUDIO's readers in mind. Thus one would have to have ten envelopes, ten sheets of paper, and ten three-cent stamps, together with the need for writing the ten letters and inscribing each with name and address. We do it all for you, assuming that you are willing to circle the items about which more information is desired and to write your name and address once. We will forward your inquiries to the organization involved, and you will receive the data you want with only one inquiry. Isn't that as simple as A B C?

In just the same way you can get more information about any product that is *advertised* in the pages of AUDIO. Note the page on which the advertisement appears and circle it on the back side of this card. When there are two or more ads on the same page, the page number is followed by a letter, and the designation appears under each individual advertisement. Write your name and address clearly—someone has to decipher it—and it is a good idea to mark the card for all the information you want the first time, for there is only one card in each copy of the magazine. Of course, you *could* subscribe to two copies.

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To get more information about the products that are advertised in each issue of AUDIO—use the new card at the left. Fill in your name and address clearly and circle the number of the page on which the advertisement appears. When there are two or more ads on a page, each one has under it a notation such as Circle 23a, Circle 48b, or Circle 76c and the same numbers appear on the card. Numbers C-2, C-3, and C-4 refer to the covers—C-2 is the inside front cover, C-3 the inside back cover, and C-4 is the outside back cover. SB is "The Sounding Board."

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(DO NOT USE THIS CARD AFTER NOVEMBER 1, 1956)

L-1	L-8	L-15	C-2	4	11	32	40	46a	47f
L-2	L-9	L-16	C-3	5	13	33	41a	46b	47g
L-3	L-10	L-17	C-4	6	14	34	41b	47a	47h
L-4	L-11	L-18	SB	7	24	35	42	47b	47k
L-5	L-12	L-19	1	8	27	37	43	47c	48a
L-6	L-13	L-20	2	9	29	38	44	47d	48b
L-7	L-14		3	10	31	39	45	47e	48c

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TURNTABLE ARM

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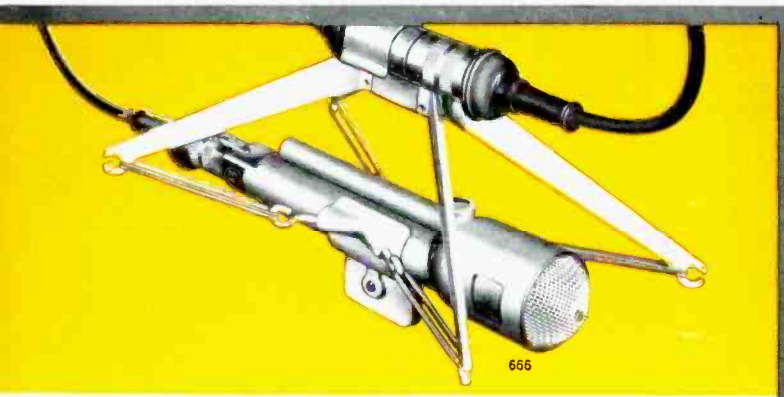

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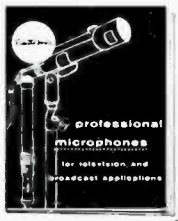

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