

AUDIO

AUGUST/1965

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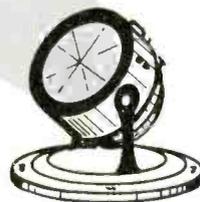
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TAPE RECORDERS

RECEIVERS

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ANNUAL PRODUCT PREVIEW ISSUE



Scott / The New Technology



At last! A powerful solid state receiver designed expressly for knowledgeable audiophiles

Scott's new 348 tuner/amplifier is *not* designed for the Mrs. . . . or for the kids. It's *not* a simplified combination unit. This compact receiver is designed expressly for the man who wants a top-end high fidelity tuner, a powerhouse amplifier, and a pre-amp with a really complete set of controls . . . yet still wants all this in one compact unit.

The 348 is a unique piece of high fidelity gear. Scott engineers have loaded it with every feature and control in the book . . . and in hi fi engineering, Scott wrote the book. It packs a powerful 100-watt punch . . . yet it fits in a *standard* 12" bookcase!

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New 348 has everything, even a sink!

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sient response, more instantaneous power for music peaks and cooler, trouble-free operation.

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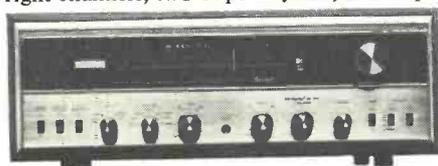
In addition, the 348 gives you a wider range of inputs and outputs than you'll find on most separate units: a switched front panel stereo headphone output; tape head, phono, and extra inputs for both left and right channels, two Tape In jacks; two Tape

Out jacks; and two AC outlets, one of which is switched.

The new Scott 348 is *not* inexpensive. Yet at \$479.95 it represents one of the best high fidelity bargains ever produced. It is superior in performance and features to the most expensive separate preamps, power amplifiers and FM stereo tuners on the market . . . and if you've added prices lately, you know you can't come anywhere near the performance of the 348 unless you spend more than \$800 on separate units.

SPECIFICATIONS: Usable sensitivity (IHF), 1.9 μ v; Harmonic distortion, 0.8%; Capture ratio, 2 db; Selectivity, 45 db; Cross modulation rejection, 80 db; Separation, 40 db; Music power per channel (at 4 ohms load), 50 watts; Steady state power per channel (at 4 ohms), 37.5 watts; Frequency response (1.0 db), 15-30,000; Hum and noise, -80 db.

Dimensions: In accessory case: front panel, 5 $\frac{1}{2}$ " x 17 $\frac{1}{2}$ "; from front foot to back of heat sink, 10 $\frac{1}{2}$ ".



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AUDIO

August, 1965 Vol. 49, No. 8

Successor to **RADIO**, Est. 1917

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Number 24 in a series of discussions
by Electro-Voice engineers



THE ENORMOUS ROOM

HAROLD MAWBY
Senior Microphone
Engineer

A major part of the recent remodeling of engineering facilities at Electro-Voice was the construction of new anechoic test facilities to supplement the present four anechoic chambers in use in Engineering, Quality Control, and Production testing.

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Two smaller chambers adjoin the main chamber. One houses the "standard" speaker used to test microphones. This speaker is calibrated from 20 to 20,000 cps with the National Bureau of Standards. A larger booth, in an adjacent corner accepts any standard size speaker to be tested, up to 30" in diameter. A standard exponential horn is also mounted for testing PA and high frequency drivers. This booth is, in effect, an infinite baffle of 250 cubic feet, padded with 4" thick Fiberglas on all surfaces, and with its face common to the larger anechoic chamber. This room may be entered without entering the anechoic chamber, thus reducing traffic and possible acoustic interference in the main chamber.

Ventilation of the main room is through hollow wedges to further reduce possible reflections. These wedges are located at three widely separated points. Twenty instrument hangers are spaced for a variety of test locations.

There are 22 electrically isolated, shielded channels available for connection to every type of signal source and test equipment. Automatic curve tracing, and servo-operated automatic polar pattern equipment speed routine measurement of microphone and speaker characteristics. The entire facility sits on its own foundation, completely isolated from the main building.

For technical data on any E-V product, write:
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602 Cecil St., Buchanan, Michigan 49107



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COMING

ARTICLES

• Development of a Pulse Modulated Audio Amplifier. Norman H. Crowhurst. A four-part article describing the development of a high - powered amplifier which is an improvement of the Class-D type described in previous articles. This step-by-step analysis should be easily understood by the experimenter and audiophan and provide a thoughtful stimulus for fresh thinking about pulse modulated audio amplifiers.

In addition there is a wealth of material useful to those who would engage in the process of circuit design with transistors: how circuit constants are selected; how to select transistors in spite of variable parameters; and some tricks in transistor applications.

PROFILES

- Sherwood Solid-State Amplifier, Model S-9900
- Shure "Solo-Phone", Model SA-1, a headphone amplifier which permits headphone listening from turntable or tuner without need for an amplifier
- Neumann Condenser Microphone System, Model U-64

In the September Issue

On the newsstands, at your favorite audio dealer's, or in your own mailbox

AUDIO CLINIC

Joseph Giovanelli



Send questions to:

Joseph Giovanelli
2819 Newkirk Ave.
Brooklyn, N. Y.

Include stamped, self-addressed envelope.

Wireless Phono Oscillators

Q. I wish to construct a phono oscillator that will be suitable for high fidelity use. What determines the frequency response that an oscillator of this type can transmit?

I would like to use this oscillator to transmit sound from my high fidelity system, pick it up via a crystal detector feeding a miniature high fidelity amplifier, and listen to the music through high fidelity headphones. I conclude that if this works on monophonic program sources, I should also be able to make it work for stereo. F. E. Pierce, APO, New York, New York.

A. The ordinary wireless phonograph should possess excellent frequency response because there are no transformers to limit the highs. The problem with these devices is not one of frequency response but of other types of distortion. These units use a single tube which acts as both modulator and oscillator. This direct kind of electrode modulation must result in frequency modulation in addition to amplitude modulation. In order to detect this kind of modulation, the receiver must be set on the slope of the signal if the selectivity of the receiver is reasonably sharp. Of course, with the crystal detector you plan to use, this is not a problem.

The frequency response of the transmitter may be reasonably wide, but the average receiver does possess sufficient selectivity so that sidebands are not fully detected, leading to a loss of high frequencies in the reproduction. Again, with a crystal detector this is not a problem.

Another problem with the transmitter is that it cannot be fully modulated because of incomplete control of the circuit by the grid on which modulation is impressed. Overdriving the transmitter will cause erratic oscillation and clipping of the amplitude modulation, further increasing distortion.

Low-power oscillators could be devised to work with low-power buffer amplifiers, with the buffer amplifier modulated by way of a transformer or by way of a series connected tube which acts as a variable resistance. This latter type of modulation again cannot produce 100 per cent modulation.

Assuming that you have produced a clean signal from the transmitter, you then must receive the signal. The signal must by law be of very low power. Therefore, if the receiver is to be placed some distance from the transmitter, the receiver must have some gain ahead of the detector. **THIS AUTOMATICALLY RULES OUT THE USE OF THE ORDINARY CRYSTAL DETECTOR.**

The problem gets more involved than this if you wish to transmit stereophonically because each channel will have to be fed into a separate transmitter. Each transmitter must be set to a different frequency so that heterodynes will not result and so that the channels can be separated from one another.

Another difficulty lies in the problem of finding a spot on the dial which is not occupied by even a weak signal. This weak signal will beat with the signal created by your little transmitter and will cause heterodynes which will detract from the quality of the music you wish to hear.

Assuming that you wish to construct a special receiver for this transmitter, you could consider operating this equipment outside the broadcast band. In that case you must design your equipment to operate at frequencies lower than the broadcast band because of the laws governing this kind of transmitter. If the equipment is to be operated on frequencies between 510-1600 kc the field strength in microvolts per meter at a distance of 100 feet from the transmitter shall not be more than 2400 divided by the frequency in kilocycles. If the equipment is operated at frequencies between 10-490 kc the signal strength in microvolts per meter of receiver antenna length at 1000 feet shall not be more than 2400 divided by the frequency in kilocycles. In any event, the signal of such a station cannot interfere with other services.

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die-cast
turntable



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Cast aluminum
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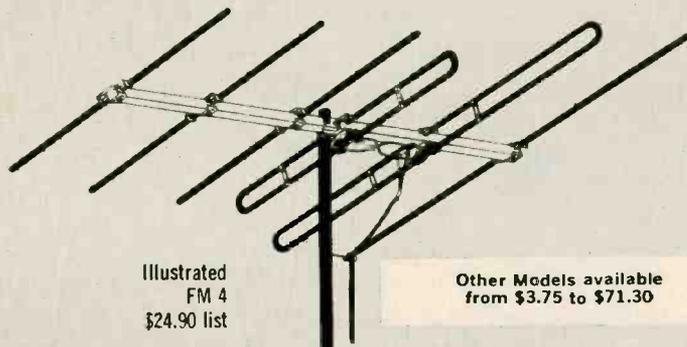
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this type can be made to work. If you are interested in this project from the point of view of an experimenter, go ahead and enjoy yourself.

The easiest way to make the transmitter is to use a tube such as a 6AN8. The triode section can be the oscillator and the pentode section can be a tuned buffer. A 6AQ5 can be triode connected and placed in series with the plate and screen supplies of the pentode half of the 6AN8. Audio is then fed to the grid of the 6AQ5. When triode-connecting the 6AQ5, the screen should be connected to the plate rather than to the control grid. This gives you more carrier. If the screen is connected to the control grid, the carrier amplitude will be reduced, but you are likely to obtain a higher modulation percentage. Because the buffer and the modulator are in series, you will need up to 300 volts to operate this portion of the circuit while 150 volts or less will be needed to operate the oscillator section of this portion of the circuit.

The limitation on low frequency performance of the equipment is the selectivity of the receiver. The lower the receiving frequency, the more selective the receiver is likely to be with a given tuned-circuit Q. You may have to trade Q and circuit gain for bandwidth by swamping the circuit with a resistor. Little more can be said here about receiver design because there are many ways of going about such a project.

Hum in Phonographs

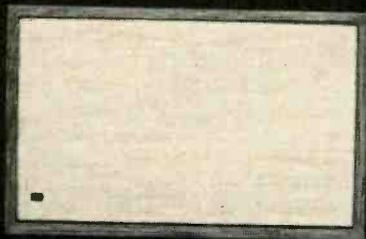
Q. I get hum either from the turntable or the cartridge. When I am playing a record, the hum cannot be heard except during extremely quiet passages and only when the loudness control is past the 12 o'clock position. When the turntable is switched off, however, the hum becomes about three times as loud and is accompanied by crackling noises. I have tried grounding the turntable to the preamplifier to no avail. Frank Proto, Brooklyn, New York.

A. Sometimes merely reversing the polarity of the wall plug of the preamplifier or the turntable can solve a hum problem.

Sometimes hum can be eliminated by grounding the preamplifier to a water-pipe or radiator. However, this often aggravates the case instead of curing it.

If the tonearm you are using is mounted on a wooden base, this means that it is not grounded even though the turntable is grounded to the preamplifier. Run a wire from one of the mounting screws of the tonearm to some point on the turntable assembly. Then ground the table to the preamplifier. I have often found, however, that it is better to ground the arm to the preamp and not to ground the turntable. \AA

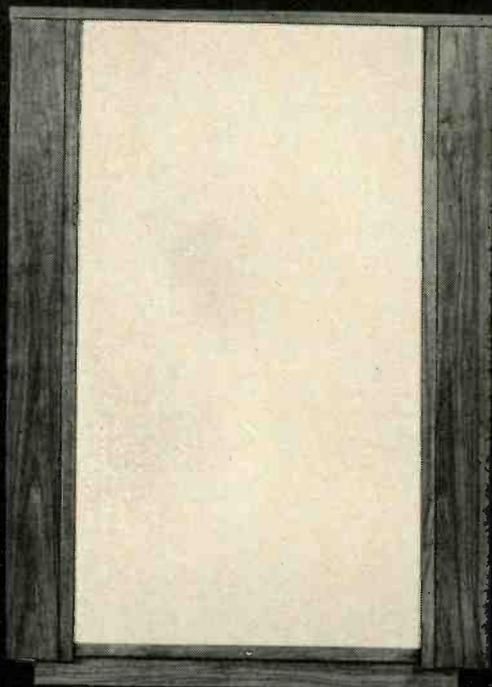
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Is It The Best?

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ARE ALL BOZAK SPEAKERS "BEST"?

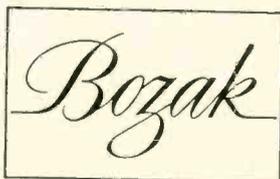
Yes.

All Bozak speaker systems are built from the same basic components. And all Bozak components are built to the same electrical, acoustical and tonal standards — the highest.

To achieve the broader, more realistic sound sources of its larger systems, Bozak simply combines the same component speakers used in more modest systems.

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AUDIO • AUGUST, 1965

LETTERS

More Bass Repercussions

Sir:

AR welcomes articles on the products of fellow manufacturers. The article "Bass Transfusion for Little Speakers" describes Altec's "Bass Energizer" designed by my colleague Alex Badmaieff.

I am sure Alex knew what he was doing, but I am afraid that authors Yeager and Hull present the case poorly, regardless of the merits of the device. As a former teacher in the field of audio, I would like to point out certain fallacies that their article promotes. I believe that the first three listed here are non-controversial.

1. Compensation for the Fletcher-Munson effect can only be based on the *difference* between the equal loudness curve at the original, live level and the curve at the reproduced level, where such a difference exists. It is meaningless to provide "compensation" which straightens out to a flat line the curve at any particular intensity level, as the authors do for the 80-db curve.

2. If the Energizer did compensate for the Fletcher-Munson effect, it would be suitable for all speakers, large or small, unless the bass response of a particular speaker were already 6 to 10 db above flat.

3. The mechanical position of the amplifier volume control for a given volume of sound in the room cannot be taken as even an approximate index of speaker efficiency or of how much of the amplifier's power is being used. The number of degrees that one must turn the volume control to achieve a given sound intensity depends on: (A) the voltage output of the cartridge, tuner, or tape machine; (B) the voltage gain of the preamplifier; (C) the sensitivity of the power amplifier, that is, the signal voltage input required for a given power output; (D) maximum power output of the amplifier; (E) the efficiency of the speaker; (F) the size of the room; and (G) the amount of absorption in the room furnishings. Speaker efficiency is not even predominant in this complex of factors, and its effect in determining the position of the volume control may easily be swamped by the other elements.

4. The article states that the Energizer will allow one to connect a 16-ohm, 35-watt rated speaker to a 70-watt amplifier with safety, and that twice as much protection is provided with an 8-ohm speaker.

Above 150 cps their graph shows a 10-db loss for 8-ohm speakers, which means that a 70-watt amplifier becomes a 7-watt amplifier. At 60 cps and below the Energizer allows all the amplifier power to go through, and provides no speaker protection. A single organ pedal tone below 60 cps, or tuner "pops," may drive the amplifier to as much power as (and produce far more speaker excursion than) a complex orchestral *fortissimo*.

The article's lack of scientific rigor on the above points may help the reader put into perspective the author's opening statement: "Loudspeaker authorities agree that it is the inherent lack of bass which prevents a small speaker enclosure from producing that full rich sound."

EDGAR VILLCHUR
Acoustic Research, Inc.
24 Thorndike Street
Cambridge, Mass.

Bass Transfusion

Sir:

I was interested in your June article on "Bass Transfusion for Little Speakers." I have been experimenting in this area of "bottom" bass for a long time.

However, I do not feel that the authors have compared their curves with a good hi-fi bass boost tone control, certainly not with the Baxandall type, nor do I feel that a six decibel boost with a drop of only 2 decibels at 100 cycles will be earth shaking.

I have experimented with bass boost, but my method was to add a separate amplifier and horn-loaded woofer to comple-

(Continued on page 70)

Reverberation Effects...

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7-03

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The new Fisher TX-300 solid-state stereo control-amplifier.

Size: 15 $\frac{1}{8}$ " x 41 $\frac{3}{16}$ " x 11 $\frac{7}{8}$ " deep. Weight: 24 lbs. Price: \$329.50. Cabinet: \$24.95,

A total IHF music power output of 100 watts is no mean accomplishment in a single-chassis stereo control-amplifier—but it is not unique. High power at low distortion can also be obtained with vacuum tubes. A really cool chassis can not. That takes transistors. So does lightweight, space-saving design without compromise. (The TX-300 weighs only 24 pounds and is less than 12 inches deep, despite its rugged, conservatively rated parts.) And the virtual certainty of unlimited life without the slightest service problems takes not only transistors; it takes Fisher solid-state circuitry, engineered for Fisher reliability.

One reason for the light weight of the Fisher TX-300 is the absence of output transformers. This has the even more important benefit of removing all limitations of bass performance and of transient re-

sponse ordinarily imposed by transformer characteristics.

Another remarkable feature is that *each* channel has *four* output transistors for conservative operation at high power, instead of the conventional *two*. The rated power of 100 watts is obtained at 8 ohms, but nearly as much power is available at either 4 or 16 ohms, via the special impedance selector switch. The IHF power bandwidth (half power at low distortion) extends from 12 to 50,000 cps!

As for preamplifier and control features, the TX-300 provides 16 inputs and 10 outputs to accommodate every type of program source, recording instrument, loudspeaker or headphone—plus 21 controls and switches for total control of the sound by the listener.

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LIGHT LISTENING

Chester Santon

Boston Pops: Tenderly RCA Victor LSC 2798

By accident or design, this latest album by the Boston Pops under Arthur Fiedler gives the audiophile a great deal of insight into the current state of affairs in the RCA Dynagroove process. Perhaps even more revealing than the sound on the disc itself is the photograph of the recording session to be found on the reverse side of the record jacket. To the best of my knowledge, this is one of the rare occasions when a fairly explicit photo of a Dynagroove mike set up for big orchestra has been made available to the public. When this particular recording system was first bruited to the industry, RCA's staff stressed new techniques in miking along with a long array of complicated devices designed to alter the sound in its transfer from master tape to finished disc. Dynagroove mike set up for big orchestra has and since that time many modifications have been made in the original system to bring it back in line with conventional industry practice. The photograph displayed on this album reveals very little that could be considered a departure from current miking procedures in recording popular music of a relaxed nature. What we have in this release is mood music on a rather lavish scale and the six mikes visible in the photo have been set up to accord with the dreamy arrangements. Scattered throughout the orchestra, the average height of the mikes is only a yard or two above the heads of the players. This placement works out well in the carefully modulated arrangements of Jack Mason and Richard Hayman as Arthur Fiedler leads the Boston Pops in an exceptionally attractive group of perennial favorites by Lehar, Coward, Weill and Youmans.

Flora, The Red Menace (Original Broadway Cast)

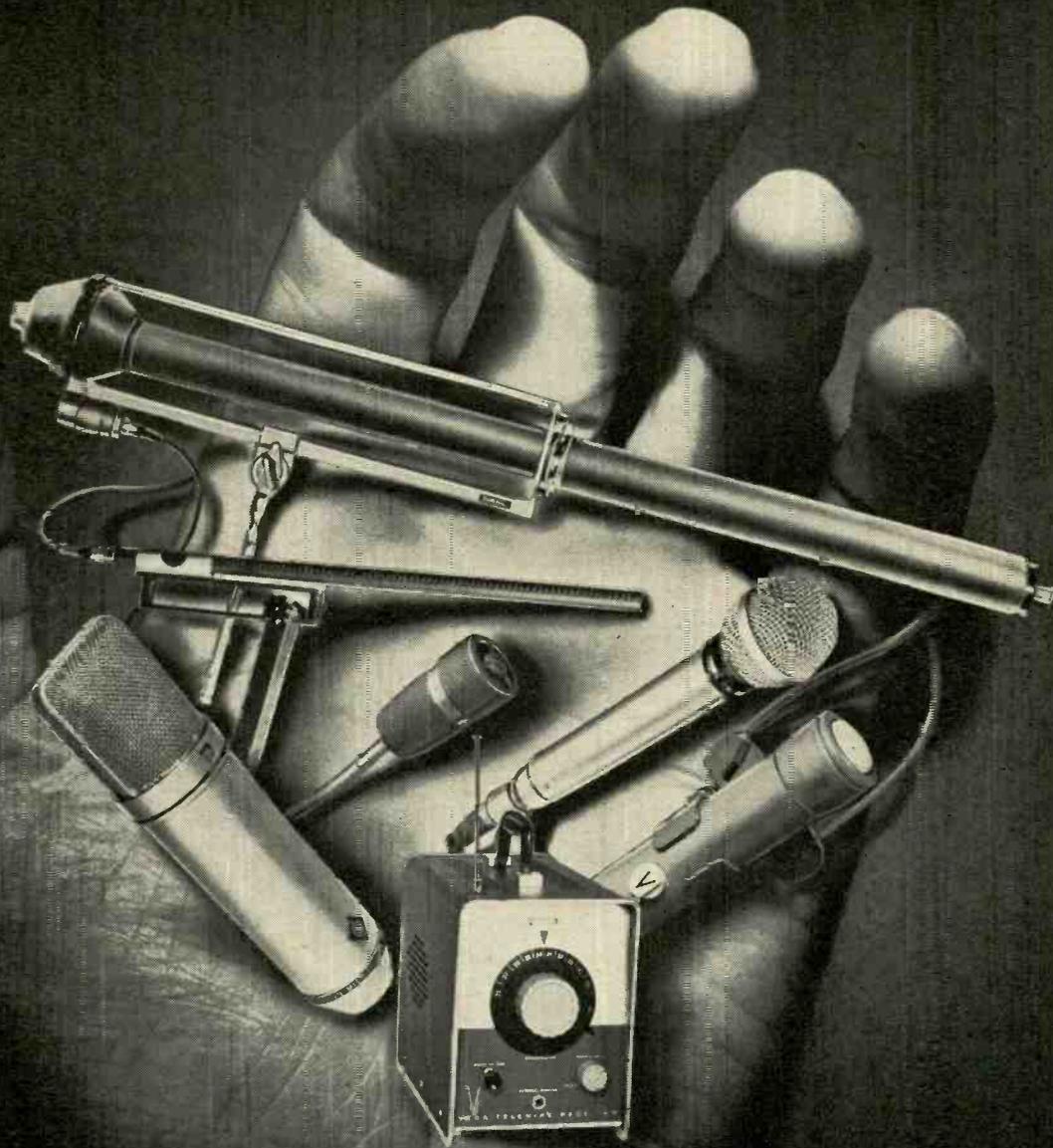
RCA Victor LSO 1111

Appearing toward the close of the current Broadway season, this musical offers two reasons for rejoicing, one considerably more important than the other. Most record buyers will find this show album noteworthy simply on the basis of its star because Judy Garland's little girl, Liza Minelli, gets her first big break on Broadway in "Flora." Readers of this column, while hardly immune to some of the broader aspects of show business human interest, will find their attention straying from the musical efforts of the cast to the technical handiwork that RCA's engineering staff has brought to the production of this album. Here is a Dynagroove release

of an original cast recording that actually succeeds in breaking away from the limitations that system has imposed on RCA Victor Broadway albums in recent years. It's a real pleasure to join other show fans in celebrating RCA's return to accepted standards of the day in giving full-range sound to original cast recordings. For the first time in many months, one can listen once again to the actual acoustics of New York's Webster Hall, scene of so many fine show albums on this label, and feel oneself part of an event. The show itself is hardly an exciting event in theatrical annals but the improved sound glosses over the fact. There is little dramatic meat in a rambling tale of a young fashion illustrator's involvement with the New York chapter of the Communist Party back in the Thirties. Liza Minelli, although only nineteen when the show opened, has a style far more sophisticated than that of many singers twice her age. Her inherited show business savvy, easily overriding any vocal resemblance to her famous mother, puts her solidly on the road to Bigger Things.

Magic Moods of Ronnie Aldrich London Tape LPL 74062

Tape fans with a memory going back six or seven years will know what is meant when I say that two-track releases of those days were easier to play than many four-trackers of the moment. It's hard to hold back nostalgia for the old days (especially since a reviewer didn't have to pay the double price of two-track reels) as one considers the four-track stereo of this latest reel in London's long-established Phase 4 Series. Whatever his opinion of the sound of two-track tapes, anyone could play them with his preamp settings pretty much where they were for phono or FM tuner and get darn good results 99 per cent of the time. It is possible to get fairly good results with today's four-track reels provided I make the following changes in my preamp settings before playing them. If a reel such as this follows a disc, the steep filter cutoff is flicked to the 10,000 cycle position. Whenever I forget to do this with a tape of this kind, I'm soon reminded by the increase in upper-frequency hash many four trackers exhibit above 10 thousand. It's a form of hash I just don't find on the average stereo disc. With proper compensation on the orchestra surrounding them, the two pianos played by Ronnie Aldrich have a better chance to shine in multiple-track arrangements of American favorites delivered with a slightly British accent.



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Edward Tatnall Canby



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Early last spring I began to work on a report on stereo broadcast listening from the layman's viewpoint which was to sum up my reactions to this form of hi-fi after a considerable absence, ever since the first splurge of interest and the earliest stereo receiving equipment of some years ago. I had deliberately avoided stereo broadcasting since then (there was plenty else to keep my ears busy) because I wanted to wait awhile until things could jell, until the shake-downs were over and the new system should reach an even keel and a basis for an evaluation of some permanence.

Well, I got me a brace of brand new tuners, on loan from their obliging makers, and went to work listening. And now I feel a bit silly. For the whole of my listening, over many months, has boiled down to one continual pre-occupation—with a fringe effect which most engineers would consider very minor in view of the enormous technical problems I know they have been faced with in this period of stereo beginnings I hear about these difficulties all the time. Multipath distortion, phasing cancellations, stereo records which won't broadcast at all, SCA problems, modulation levels, wandering stereo images and a host more. I've read all about them. But I didn't *hear* them. None of these problems plagued me as they were supposed to. I only heard one thing (aside from assorted interference and such) that really bothered me. Steady background noise on stereo. A gentle, unobtrusive fffffffffffff, heard on all stations, no matter how powerful. A kind of "surface noise," and I couldn't get rid of it, except by switching to silent mono. Everything else was fine, allowing for the vagaries of various stereo broadcasters and the on-again-off-again stereo hours (but that is another subject). Stereo came in loud and strong from many stations. Always with background noise.

These same stations, and many more, come in on mono with absolute silence in the background—that utterly restful, velvety silence which for so many years

has been FM's pride and joy. Full limiting! Down goes the hiss, down and OUT. No background sound whatsoever. Nothing can match that effect.

On stereo I just couldn't get it. Instead, there was always the persistent, irritating residue of noise, like the surface noise on the old 78-rpm records. It isn't a loud noise, nor is it violent. It doesn't obscure the music, except in the faintest passages. (But how wonderful they sound against sheer silence!) It doesn't hurt. It isn't a true distortion. It is just *there*.

And because it is there, and especially because *you can kill it instantly by switching to mono*, this mild sound-residue seemed fairly to scream its defiance at me. I grew to hate it. I wanted to swat it, like a mosquito in the night, for sudden silence. I wanted to turn it off like the ventilation system in a large hall—with silence flooding in, like a balm for the soul! But I couldn't turn it off. It wouldn't go away. Except on mono.

2½ to 9½

Now this little residue of background noise got me interested in the technicalities. It shows some rather peculiar characteristics. They seemed odd to me, at any rate, until I'd studied them for a long time.

For instance, at my country listening post, 100 miles from New York, I can pick up most of the city FM stations with a strong signal. On the meter of one of the tuners, calibrated from 1 to 10, a number of stations hit up to 9 or 9½ and many of them swing the needle up to 6 or 7. On this same tuner, a reading as low as 2½ gives full limiting on mono. It would seem, then, that the stereo signal should be strong enough to banish that background noise. It doesn't.

In fact, the oddest thing is that the residue of "surface noise" sound seems almost constant all the way from a reading of about 4 on that meter up to the maximum of 9½. Virtually no reduction. Thus over the entire practical range of fully-limited mono FM, I received stereo background noise of the same uniform quality. Couldn't get rid of it,

even at 9½. Over this entire range, in station after station, mono is 100 per cent silent (not counting those passing planes) and stereo is *always* equipped with a background.

I got so worried about this that I went and tried several tuners—I thought that it might be a fault in one of them. No such thing. I haven't tried all the tuners available. There may be a tuner, or several of them, which can pass my fringe-area background-noise A-B test—quick switching from mono to stereo and back again. That is, no audible difference in the silent background between the mono and stereo modes. I haven't heard one yet. I found the same "surface noise" coming through in the same way on several different makes, at this 40-100 mile location. And I've heard it elsewhere, too, as I've snooped into various friends' living rooms. (Some of them hadn't noticed it at all. Lucky them. I heard it only too easily.)

My conclusion is that for *fringe-area listening*, stereo background noise is more or less of a fact of life. You can take it (stereo) or leave it (switch to mono).

Now, I'm the most ardent stereo lover around. I love stereo, understand it, crave it, and genuinely dislike having to listen to mono sound. Yet, sad to relate, I find that in the country I mostly switch over to mono after a few minutes. Stereo is fine, but I like *total silence in the background* even better. After all, that's what first sold me on FM, back as long ago as 1943. That's what I get, too, on stereo tape. I get very nearly total silence on stereo discs. So *must* I go back to the 78-rpm era of background noise, in order to listen to stereo on the air? That's what it amounts to.

I see an apoplectic flush rising up in some of our readers, notably those who make or promote broadcast stereo equipment. And so I hasten to make a big qualification. A huge, enormous, whopping, splendid qualification. My report, as anybody can see, is strictly a minority report. From the outer fringe. Stereo in town is OK.

Big City

For of course, I had to try stereo in the Big City, too. What was it like there? I hauled all my equipment to my New York apartment just to find out. Aha! *Silence!* In the Big City, stereo is just wonderful. Not a hiss to be found, except maybe a legitimate bit of noise on a particularly weak station. Full "limiting"! Switch from mono to stereo and back to mono and there is **NO** change in the background noise level on most of the major stereo stations. And this,

(Continued on page 99)

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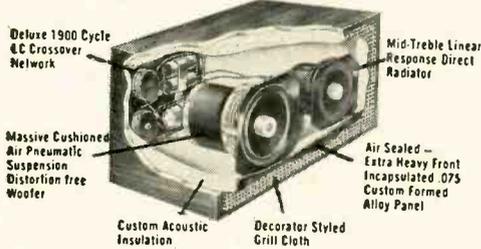
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the MAXIMUS 2 — This middle-size brother to the compact MAXIMUS 1 handles twice the power, extends the bass range down to 35 CPS. It measures only 14½" x 11" x 8". MAXIMUS II uses two of the new MAXIMUS woofers, and the unique mid-range/high frequency driver to provide an uncanny audio mirror of life-like projection of mono or stereo sound. 35-20,000 CPS. 8 to 16 ohms. Net Price \$109.00

the MAXIMUS 3 — Biggest brother . . . but still only 18" x 12¾" x 10" . . . the MAXIMUS III employs 4 MAXIMUS I woofers to give extraordinary precise critical damping for perfect transient response. Ideally suited for use with the newest high-powered Transistorized High Fidelity amplifiers. At 1900 cycles a Deluxe LC crossover network transfers the electrical drive from the 4 woofers to 2 MAXIMUS mid-range and high frequency units. 30-20,000 CPS. 8 to 16 ohms impedance. Net Price \$169.00



the MAXIMUS 4 — 2-Way Speaker System

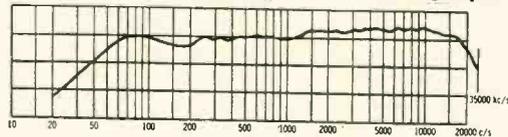
The MAXIMUS 4 features the newest 8" version in the family of CAPS woofers. The total inter-modulation distortion from 100 to 20,000 cycles is less than ½%. The distortion at 40 cycles is less than 3%. The pneumatic suspension woofer has an ultra efficient 3½ lb. double duty ring magnet structure with a total flux of 17,000 gauss. At 1800 cycles the audio drive is transferred to a shielded back-loaded mid-treble lens speaker. A continuously variable KONTOURED ACOUSTIC control is supplied to provide acoustic room tailoring to suit individual taste. The frequency response is virtually flat from 35 to 20,000 cycles. Oiled walnut enclosure finished on 6 sides. Removable grill cloth. 40 watts IHFM. Impedance: 8 to 16 ohms. Size: 21¾" x 11¾" x 11¾". Net Price \$97.50

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 from 50 CPS to 35,000 CPS | at 30 CPS

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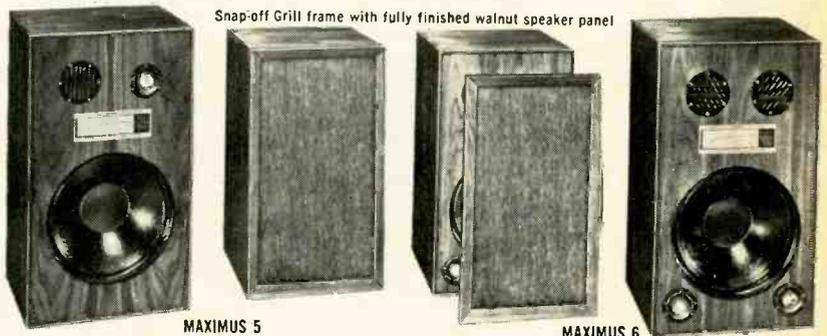
ments. Uniform response from 25 to 35,000 cycles. Total distortion less than ¾% from 50 to 35,000 cycles. Distortion at 30 cycles less than 3%. Impedance: 8 to 16 ohms. Size: 24" x 14" x 12". Finished on all 6 sides, oiled walnut cabinet with air-tight sealed enclosure and custom designed removable decorator style grill. Net Price \$189.00



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Deluxe 1800 & 8000 Cycle LC Crossover Network
 Exclusive Acoustic Contour Controls
 Heavy Duty 12" Woofer



MAXIMUS 5

MAXIMUS 6

the MAXIMUS 6 — 3-Way Speaker System — The MAXIMUS 6 boasts tremendous, vital, uncanny bass, precise transient control, and virtually flat response from 25 to 22,000 cycles. The CAPS woofer will handle 75 watts of IHFM music power and responds to high power excursions at less than ¾% distortion. The MAXIMUS 6 requires only 3 watts of audio driving power to fill a large listening area with superb sound. The MAXIMUS 6 utilizes a pneumatic suspension woofer having a 9½ lb. double duty ceramic magnet structure, two shielded back-loaded wide dispersion bipolar mid-treble lens speakers, and 3-way LC crossovers at 1800 and 8000 cycles with continuously variable mid-treble KONTOURED ACOUSTIC controls for individual acoustic listening requirements. Handsome oiled walnut enclosure with removable grill cloth. Impedance: 8 to 16 ohms. Size: 24" x 14" x 12". Net Price \$169.50

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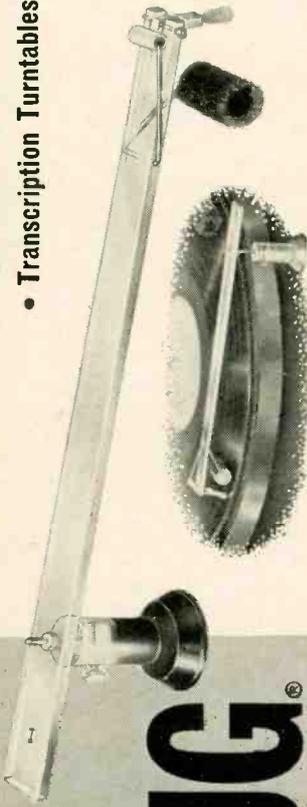
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ABOUT MUSIC

Harold Lawrence

Composition—A Life Or A Living?

The photograph of Johannes Brahms gazing at the trees from his veranda window is to many the epitome of the nineteenth-century composer—a man permitted to devote his full time and self to composition. Money and patrons somehow protected him from those worldly cares which, as the early Italian composer, Palestrina, put it, "are adverse to the Muses." Even when financial security was missing, the composer persevered, never allowing himself to be deflected from his chosen path. Rich or poor, celebrated or ignored, he could be found at his work desk or piano, pen in hand, stopping only to take in a gifted pupil, conduct a performance of his own music, or write his memoirs.

An oversimplification, of course. But the life of the composer in the Romantic Era differs radically from that of his Twentieth-century counterpart. Less than a dozen serious-music composers in the United States make a living entirely at their craft. Other composers support themselves in a wide variety of ways, some wholly unrelated to music.

In 1961, the American Music Center mailed a questionnaire on income to 1,171 composers. 430 replied. Of these, only 16 reported earnings of \$5,000 or more from their music. The top earner took in \$103,824 in a single year; the second chalked up \$26,000; then there was a drop to \$12,000 (six in this category), and the last group of seven brought in between \$5,000 and \$10,000. Seventy composers reported incomes of between \$1,000 and \$5,000; 106 made between \$100 and \$1,000; 77 earned less than \$100, and 145 earned zero.

Even in the Great Society, man cannot live by composing alone. To round out his income, the composer is a motion picture animator or a lobster fisherman; he sells television sets and wholesale jewelry, he is a rate analyst in a traffic department, a coffeehouse owner, a radio announcer, a real estate agent and a psychiatric social worker. According to the American Music Center survey, however, a majority (343) of the composers listed teaching as the



Fig. 1. Brahms on the veranda of his home, March 26, 1894. (from "Brahms" by Walter Niemann, Alfred A. Knopf, 1929.)

"mainstay" of their income; 92 earned significant income from performing, and a lucky 44 had independent means. "Only occasionally does he hold down a job that is not connected with music," writes Virgil Thompson in *The State of Music*. "He plays in cafes and concerts. He conducts. He writes criticisms. He sings in church choirs. He reads manuscripts for music publishers. He acts as music librarian to institutions. He becomes a professor. He writes books. He lectures on the Appreciation of Music."

Beethoven would have hurled his ink pot at such a "busy" composer. "It must be the aim and aspiration of every true artist to place himself in a position in which, undisturbed by other duties or by economic considerations... he can devote himself to the composition of larger works and present these to the public upon their completion."

Not many composers have managed to live out this Romantic conception of the artist-creator. Schumann was a musical journalist; Mahler was an im-

(Continued on page 102)

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EDITOR'S REVIEW

ANNUAL PRODUCT PREVIEW ISSUE

IN THIS ISSUE we present our Annual Product Preview. Regrettably, as a well-known radio comedian always said at the end of his show, "We're a little late, folks . . ." As in the past, we provide specifications and descriptions of a large variety of products—actually some 719 separate products from 130 manufacturers—but this time in an entirely new format. Instead of column after column of type, we have resorted to a chart form of listing, with more products of each manufacturer given space than ever before. Furthermore, we believe that the chart form provides more information in a given amount of space than the type descriptions ever could. In any case, we did learn that the preparation of thirty-four of these charts was a massive job—which accounts for the lateness. The Product Preview Section begins on page 32.

If the information in this section is of value to our readers, we have accomplished our mission. Not as many pictures are given, it is true, but it must be admitted that one receiver (amplifier, tuner, bookshelf speaker, tape recorder) looks quite a bit like any other receiver (amplifier, tuner, bookshelf speaker, tape recorder). The manufacturers' advertisements will show you the appearance of their products.

One word of explanation, as always: Not every manufacturer is represented, usually because the missing ones failed to return our detailed questionnaire. Not all of their products are listed, because we had to restrict each one to five of each category. Not always did we have enough space for "notes," but in most instances where an asterisk appears in the charts it refers to the Notes at the right side.

One thing that will be apparent from the chart form is that for many of the columns, every listing seems to be about the same. Everything is flat from 20 to 20k cps; distortion is uniformly low; sensitivity is always high (represented by a low numerical value). If we use this format next year, we shall certainly simplify it—if only to reduce the total number of pages.

All in all, we are proud of this impressive accumulation of figures, in spite of all the work it entailed. We can only hope that you, the reader, will find the information useful.

It is suggested that after thoroughly digesting these specifications, the reader remember the fallibility of any set of specifications. The fact is that specifications *per se* are not sufficient to pinpoint the performance characteristics of a product at present, especially transducers such as phono pickups and loudspeakers. The difficulty here is not so much that specifications are not potentially very revealing, but rather that no standards exist to define the meaning of each specification. Thus we may have two different products with apparently different performance according to the speci-

fications supplied by the manufacturer, but which have almost identical performance when measured to the same standard. Or a product which *appears* to be inferior may actually be superior.

We raise this point for a simple reason; we recommend that you listen to a product with appropriate and familiar source material in a proper environment before arriving at a conclusion as to the merits of a product. Of course, if you have a friend or dealer whose judgment you trust, draw upon his knowledge. In either case, use specifications as a rough guide rather than a definitive answer.

WHAT WOULD YOU LIKE?

The Institute of High Fidelity has decided to continue the Seminars in Sound series which was so successful at the New York High Fidelity Show last year. For those who didn't get a chance to attend, the seminars provided discussions of a variety of audio topics by some of the most qualified people available. The Institute wants to gear the Seminars at future shows to the interests of the audience. For this reason they have asked us, and in turn we ask you, what you, the show attender, would like in the way of Seminars. If you would like a particular topic discussed, write to the Institute of High Fidelity, 516 Fifth Avenue, New York, N. Y. They will try to respond to your desires if they can. They cannot respond unless you write.

"FAST-MOTION" MOVIES

Coincident with the first appearance of the new feature column, "SOUND AND SIGHT," it is incumbent upon us to remark on some of the "Sights" encountered on TV presentations of pre-sound movies. If the motion picture industry ever approached art in its product, it was in the later days of silent pictures, which, as everyone but those in the present-day TV industry knows, were shot at 16 frames per second. When they are shown at the sound speed of 24 frames per second, they appear ludicrous, making a farce of the most dramatic scenes. We will concede this type of presentation in commercials intended to be funny, but certainly not in "historical" presentations of the old movie classics. We realize, of course, that current film equipment all operates at 24 frames, but haven't these TV producers ever heard of optical printing to overcome this problem?

Well, it's like this—you take an old 16-frame movie and dub it onto another film, printing one frame once, then the next frame twice, the next once, and so on. Then when it runs at 24 frames, it appears to run at the proper speed.

Actually, it is a simple and automatic process on the proper equipment. And it would make the fine old silent movies so much more real—and really enjoyable.



Nine out of ten musical people prefer the sound of Pickering.

Nearly all musical people prefer *natural* sound. And natural sound begins with Pickering. Right where the stylus meets the groove.

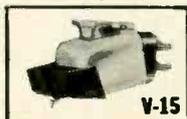
Any of the new Pickering V-15 stereo cartridges will reproduce the groove, the whole groove and nothing but the groove. That's why a Pickering can't help sounding natural if the record and the rest of the reproducing equipment are of equally high quality.

To assure compatibility with your stereo equipment, there are four different Pickering V-15 pickups, each designed for a specific application. The V-15AC-1 is for conventional record changers, where high output and heavier tracking forces are

required. The V-15AT-1 is for lighter tracking in the newer automatic turntables. The even more compliant V-15AM-1 is ideal for professional-type manual turntables. And the V-15AME-1 with elliptical stylus is the choice of the technical sophisticate who demands the last word in tracking ability.

No other pickup design is quite like the Pickering V-15. The cartridge weighs next to nothing (5 grams) in order to take full advantage of low-mass tone arm systems. Pickering's exclusive Floating Stylus and patented replaceable V-Guard stylus assembly protect both the record and the diamond.

But the real payoff is in the sound. At least for those who can hear the difference.

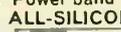


Pickering

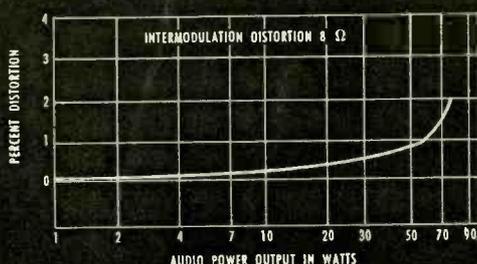
Plainview, L. I., N. Y.

For those who can **hear** the difference.

WIN a \$1000 stereo system or any of 125 other prizes! To become eligible, simply identify the musical people pictured above. See your hi-fi dealer for entry blanks and full details.

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0.1% distortion



... and All-Silicon too!

Chart reprinted from test lab report, May, 1965, *High Fidelity*.

Are you ready to step up to a Sherwood? You are, if what you seek is the "transparent", "life-like" reproduction resulting from 0.1% distortion previously obtainable only in bulkier, more-expensive basic amplifiers. And, did you know that *only* Sherwood features ALL-SILICON solid-state circuitry in every amplifier to earn the industry's most enviable reliability record? This is why experts confirm again-and-again... *Sherwood is the best!*



Paired in "Geminii" walnut cabinet @ \$38.50 is Sherwood S-9000 Solid-State 150 watt amplifier, \$299.50, and S-3000V FM Stereo tuner, \$165.00.

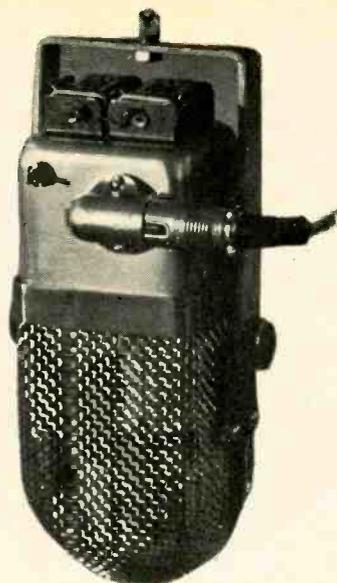
Sherwood

Sherwood Electronic Laboratories, Inc., 4300 North California Ave., Chicago, Illinois 60618 Write Dept. A-8

Circle 119 on Reader Service Card

AUDIO • AUGUST, 1965

A "New"



Ribbon Microphone

CHARLES P. FISHER*

ALTHOUGH condenser microphones appear to monopolize recording work these days, here and there older ribbon models are still in use. The technical paragraphs in record liner notes which tabulate batteries of assorted microphones often include an RCA 44BX "for rich bass." Some superior records are currently made entirely with ribbon microphones, often much modified by their die-hard champions.

This ancient and wonderfully simple device, which goes back to the early days of radio, has many theoretical virtues. It is capable of very good bass response, and extremely linear performance over a considerable bandwidth. High-frequency response is free of the peaks which characterize many condenser microphones.

The usual ribbon microphone is a passive element; it contains no amplifiers and uses no external power. It has no "mind of its own." Its sensitive element is a loosely suspended strip of aluminum from 25 to 100 millionths of an inch thick. Because most of its resonant properties lie below the useful *President and Chief Engineer, Cambridge Records, 473 Washington St., Wellesley, Mass. 02181

spectrum, it presents mass only to acoustical energy, and thus responds most predictably. Its mechanical resonance can be kept well below 20 cps, and in an efficient magnetic circuit this can be damped electrically to any desired degree.

Another virtue of the ribbon microphone is its response pattern, which changes less with frequency than in condenser types. The diaphragms of these, even when the mechanical resonance is critically damped, show a rise in on-axis response when the wavelength approaches the capsule diameter (diffraction effect). At these same frequencies there is a disproportionate loss at angles approaching 90 degrees, because the "near" and "far" portions of the diaphragm respond to opposing phases of the signal. Such microphones become increasingly narrow-angle devices with increasing frequency.

A ribbon suffers the same loss of output to high-frequency sources off axis in the plane of its length, but not in the plane at right-angles, because the ribbon is much narrower than even the shortest useful wavelengths. Musicians are usually disposed in a horizontal plane, and ribbons in a vertical; sounds are therefore "picked up" strictly in

proportion to position, not frequency.

Unfortunately, most ribbon microphones lack flat response up to 15 kc (which is certainly necessary by today's standards) except when assisted by electrical or acoustical networks. To the extent that these resemble resonant circuits, they require a cycle or two to "get going," and thus fail where needed most, in transient response. When the intrinsic high-frequency response is adequate, it is usually at the expense of signal-to-noise ratio, for reasons to be explained.

Finally, the potential of the ribbon principle is often obscured by the necessary use of two transformers between it and its amplifier. The first is required to raise the signal level to a voltage suitable for long cables, and the second for matching to grid impedance. The pair is seldom under the control of one designer and fails to do justice to the transducer. An effort to improve this situation in the course of using ribbon microphones was in fact the starting point of this project.

An appeal for help from a transformer specialist received a most provocative reply: why not dismiss the line-to-grid transformer and design a system around a solid-state operational amplifier the size of a matchbox, combining straight-edge flat frequency response, enormous input impedance and low-impedance high-level output? As a result, it was presently found that an RCA 44BX could indeed drive such an amplifier via a (rather special) transformer, and in turn, an Ampex 351 with no line-to-grid transformer. The signal-to-noise ratio was at least as good as in the conventional situation, and the microphone's true performance was delivered to the tape.

At about this stage Mr. David Hancock, a long-established independent recording engineer, very kindly provid-



Fig. 1. A new professional - grade ribbon microphone with self-contained solid-state output system. Note batteries and switch.

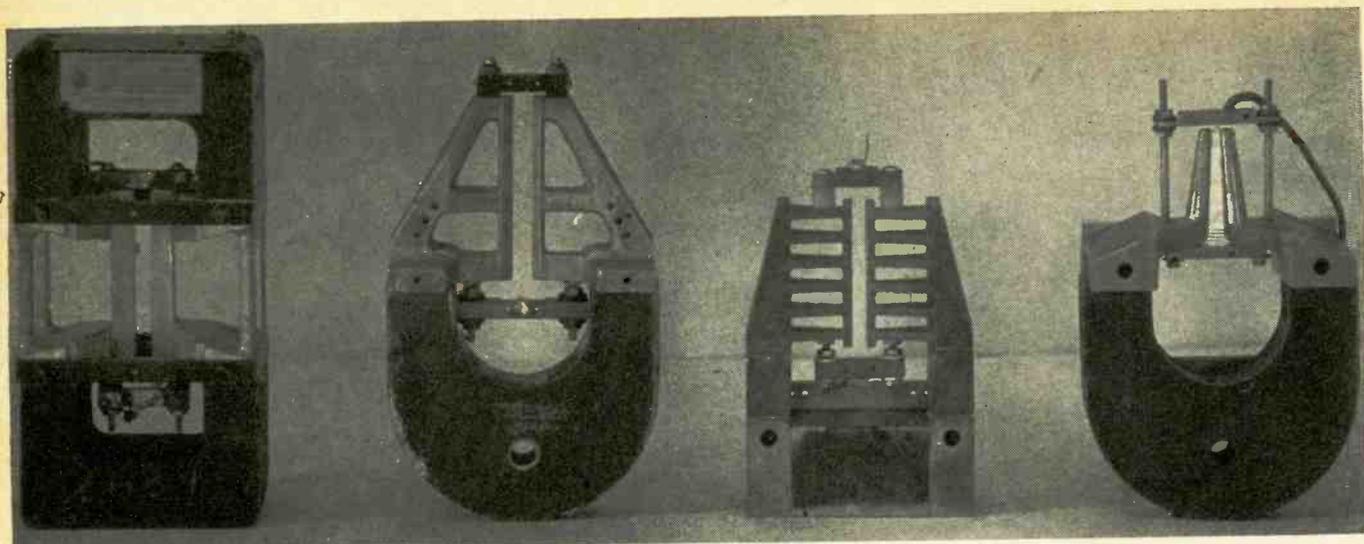


Fig. 2. Skeletons of various ribbon microphones. Left to right: RCA 44BX; RCA 44A; the author's first design; the author's "calibration" model.

ed the author with a pair of his "improved" RCA 44A microphones. Hancock long ago decided in favor of ribbons for his own use, on the theoretical grounds already mentioned, and concluded that the 44A's were potentially the best models ever made. He acquired some that were being scrapped by a radio station and worked out extensive modifications. These included the removal of various inner screens, fitting high-energy Alnico magnets, improved transformers, and very thin ribbons. He has made a considerable number of excellent commercial records with these microphones, as has the author.

In due course, the transistor amplifier output system was tried on the 44A's and the results were most impressive, except that the signal-to-noise ratio was inferior to that of the 44BX's, partly due to the extended high-end response. It also developed that there were two significant dips in the upper part of the response curve; this was the point at which a fresh design effort was undertaken.

The objectives were simple: starting from 44A performance, smooth out the curve, improve the signal-to-noise ratio 6-10 db, at the same time shortening the ribbon to improve off-axis high-frequency response, and incorporate the solid-state output system. For studio and location recording work, several commercial considerations could be foregone. A bulky package costing in the neighborhood of \$500 emitting strong external fields could be tolerated, as well as the hazards of drafts and shock. (The shock hazard has been much exaggerated; ribbon damage results from strong air streams, not accelerations due to gravity.)

As in most design problems, two or more laws of nature are in conflict here. The parameters which improve signal-

to-noise degrade bandwidth. More precisely:

High S/N = large iron parts, strong field, narrow bandwidth

Wide bandwidth = small iron parts, weak field, low S/N

The flux-carrying members which deliver flux to a ribbon are called baffles because they establish the pressure differential to which it responds. At some high frequency the acoustical path around the baffles approaches a wave length, the pressure differential approaches zero, and so does the output. The effect is the reciprocal of that in infinite speaker baffles; they work at frequencies *above* those where the front-to-back path is a wave length, ribbon microphones, *below*

The transducer efficiency is limited by the field strength (or the capacity of the iron parts to supply a field) as well as by the conductivity of the ribbon. Aluminum cannot be improved upon for ribbons, nor iron for carrying flux, but there are many configuration possibilities. The problem is like that of the automobile radiator; the freest passage of both water and air, at right angles, is required. Various designs exist (and some new ones tried in the course of this

project) which attempt to deliver maximum flux through spidery iron structures to very slender baffles (see Fig. 2). Such designs do give extended high-frequency response at good signal-to-noise ratios, but the spidery structures act as partial baffles to larger wavelengths, determined by their over-all dimensions. The resulting response curve consists (typically) of two plateaus, a high one up to some point in the mid-range, and another, several db lower, from there on. The conclusion is that any structure approaching the ideal must completely combine the functions of baffles and flux-carrying members, with a minimum of appendages and plumbing. Slender baffles providing very strong fields can be achieved with very narrow gaps, but it can be shown that the resulting ribbon resistance, and consequent thermal noise, has increased more than the signal voltage.

The present design combines a ribbon of adequate dimensions for conductivity with magnetically saturated baffles as large in section as the necessary bandwidth will permit. Figure 3 shows the construction. The generous supply of Alnico is located as remotely as is practical from conical baffles of 50-50 cobalt-

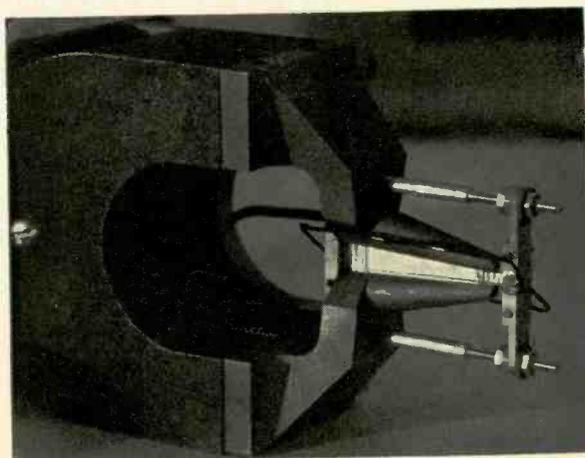


Fig. 3. Construction details of the new ribbon microphone; dimension across magnet is 3-in.

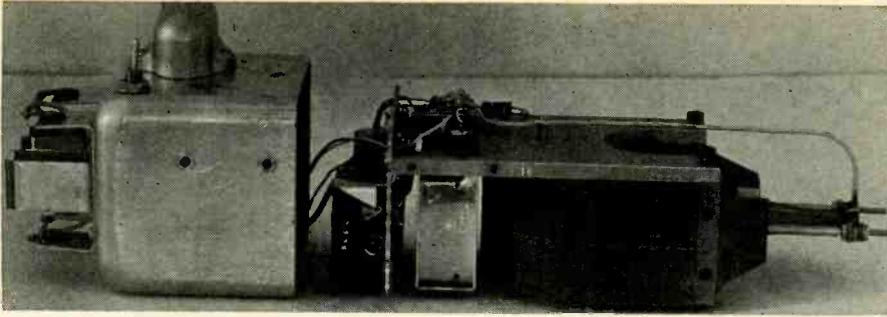


Fig. 4. Self-contained output system, showing the emitter-follower, and behind it, the transformer. The amplifier adjoins the magnet.

iron alloy. This high-saturation density alloy passes 25 per cent more flux than is possible with ordinary iron, or, permits an 11 per cent increase in "cut-off" frequency for a given field strength. The novel feature of the design is the converging baffles in conjunction with the tapered ribbon (Pat. applied for). This arrangement yields a higher product of field density and ribbon area than would be possible with a conventional configuration using a "maximized" equivalent baffle design. In terms of performance, the result is an improvement in the ratio of bandwidth to noise. With the dimensions used, the response is substantially flat and the pattern quite uniform to 15 kc, deteriorating only gradually through another octave. The signal-to-noise ratio is of the same order as that of a good condenser microphone.

The development work was carried out without access to an anechoic chamber, calibrated microphone, or level recorder, and thus required improvised test methods to yield facts, plus or minus a db or two, and to correlate reasonably with subjective judgment. The facilities consisted of a live room 22 x 30 x 11 ft., high-quality amplifiers and speakers, an assortment of reputable condenser and ribbon microphones, a pair of Ampex 351 tape recorders, a 'scope, an audio signal generator, a Blonder-Tongue Audio Baton, and an antique harpsichord. The last item is a superior research tool; besides a rich and extended harmonic structure, it possesses fundamental pitches down to 44 cps, and is impossible to record and reproduce with deceptive "A-B" fidelity.

Response curves were run by plotting 'scope readings of the first few cycles of oscillator tone bursts, the size of the room providing a short interval before the development of standing waves. With practice in reading the 'scope and careful attention to standardized microphone and speaker positions, it was possible to obtain repeatable results within plus or minus 1 db down to 60 or 80 cps.

General judgements were made by attempting to identify the short-comings of harpsichord tapes. These were veri-

fied to a useful extent by correcting the playback system with the Audio Baton (a black box with which any octave in the spectrum can be individually cut or boosted). It eventually became possible to treat the playback system as a constant and to distinguish just the microphone idiosyncrasies. The high-end peaks of the condenser microphones converted the silky "top edge" of the harpsichord sound to metallic sizzles and breaking-glass effects. Inferior ribbon models gave the effect of a bad piano. The best results were obtained with the present design, although it must be admitted that the rear response tended to emphasize the small-room effect, which is often unattractive.

This brings up a general observation on the figure-eight pattern which is inherent in a simple ribbon microphone. Because most hall reverberation is at low frequencies, and because most ribbon microphones are weak in the highs, the combined front and rear response adds up to the "rich bass" effect associated with ribbons. When, on the other hand, a ribbon microphone has good high-frequency response, and its naturally narrower response pattern is used intelligently, superb results can be achieved except in very live halls. Ex-

tensive work with the new design in various locations has confirmed this. The exclusion of early reflections from the sides of the hall in return for a smooth response to those from the rear, which are typically later and of lower intensity, yields a very pleasant combination of definition and natural hall sound.

The linearity of the final design was verified (except in the bass) by building and testing a "calibration" 2/3-scale model (see Fig. 2). Its response curve tracked very closely with that of its parent up to 20 kc, confirming that the various kinks in the curves were due entirely to the test speaker and not to dimensional effects in the microphones. (Had any irregularities been duplicated at a 3-to-2 frequency ratio, the opposite would have been proved.)

The self-contained output system (shown in Fig. 4 and 5) is basic to the good performance of the new design in guaranteeing delivery of the signal through any amount of cable to associated equipment, without the use of a second transformer. The heart of the scheme is a Philbrick Operational Amplifier type P65 AU; it is driven by a special transformer with four primary sections interleaved with six secondaries, wound on 0.006 in. Supermalloy laminations. The very high input impedance does not effectively load the transformer secondary, whose 15,000-ohm impedance is near optimum for the best noise figure of the amplifier (about 1 db). The turns ratio is 180:1 or about half that in the conventional two-transformer situation. The open primary impedance is approximately 4 ohms at 60 cps, rising with frequency to over 15 ohms before leveling off due to distributed capacitance and leakage reactance. The primary impedance is substantially higher than that of the ribbon except

(Continued on page 97)

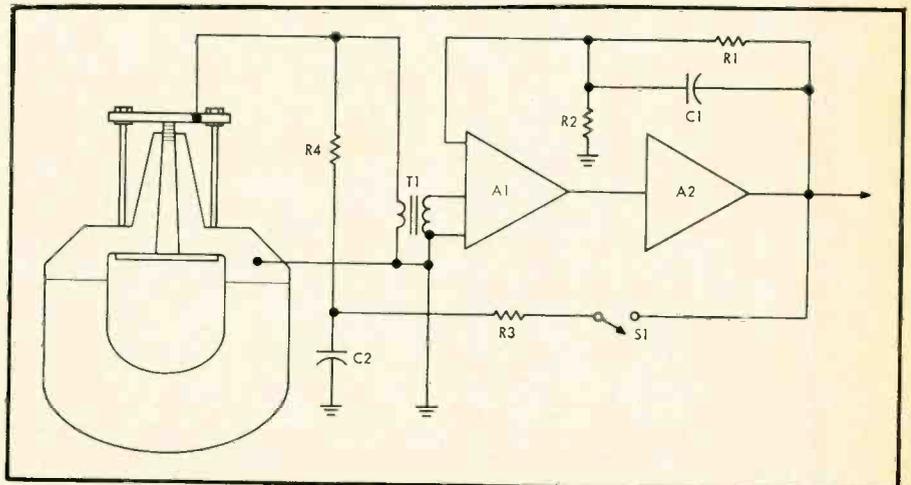


Fig. 5. Block diagram. A₁ is Philbrick P65 AU amplifier; A₂ is Philbrick PP66 emitter follower; R₁ and R₂ is the principal feedback circuit; C₁ is r. f. degeneration; R₃ and R₄ bypassed by C₂, is bass rolloff, switched by S₁; T₁ is a special transformer, described in text.

Putting Junkbox Meters To Work

DONALD R. HICKE*

Simple design equations are included to convert a junkbox meter movement into a useful voltmeter or ammeter. An ohmmeter can also be constructed if the meter scale is marked in ohms.

WHEN BUILDING ELECTRONIC EQUIPMENT, it is often desirable to include an ammeter or voltmeter right on the front panel. A variable-voltage power supply, for example, is practically useless without a built-in voltmeter. In many cases, however, the cost of purchasing a meter especially for that equipment would be prohibitive, and it is often built without the meters.

This need not be the case if there are a few discarded meters of any type in the junkbox. Within certain limits, which will be discussed later, it does not matter if the scale is marked milliamperes, kilovolts or good/bad; it is the basic meter movement inside which is important. This article will show how to determine the characteristics of the meter movement, and how to design the calibrating circuits to use it as a voltmeter or ammeter. The design of an ohmmeter will also be explained, for those who may have need for this special circuit.

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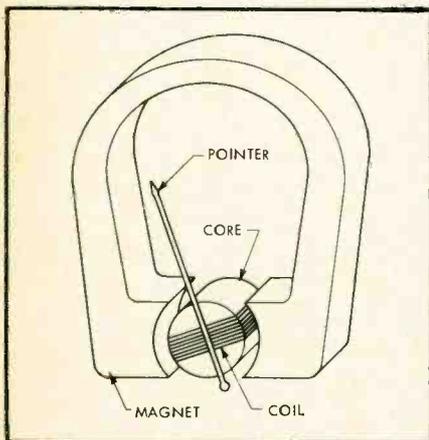


Fig. 1. The meter core is almost completely surrounded by the uniform field of a permanent magnet. The deflection of the pointer is proportional to the current in the coil.

The Basic Meter Movement

The ordinary moving-coil meter, sometimes referred to as a d'Arsonval meter, is shown in Fig. 1. A soft-iron core is fixed between the poles of a horseshoe-shaped permanent magnet. A coil of fine wire wound on a very light form is mounted on jeweled pivots so as to be free to rotate in the air gap between the core and the magnet. The poles almost completely surround the core to produce a radial magnetic field which is at right angles to the sides of the coil throughout its useful rotation. When there is a current in the coil, there are equal and opposite forces developed at each side, causing it to try to rotate. These forces, which together are referred to as a torque, are proportional to the magnetic strength of the magnet, the size of the coil, and the amount of current in the coil. If the coil is

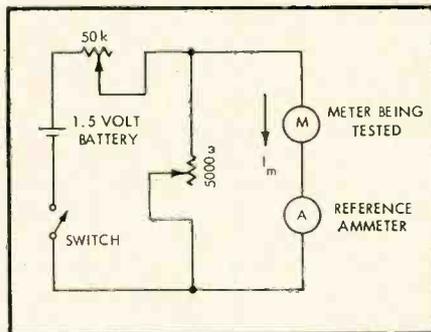


Fig. 2. Full-scale meter current I_m is measured directly with another ammeter. The reference meter must be reasonably accurate.

restrained with a spring and a rigid pointer attached to the coil, the deflection of the pointer will be directly proportional to the current in the coil. Thus, whether the scale is marked in terms of kilovolts, ohms, or per cent quality, the meter movement inside will measure current. It is this feature of a meter that is used when designing the circuits for a complete instrument.

In order to use the meter movement in an instrument, it must be adapted to give the correct full-scale reading for the quantity being measured. This is accomplished by adding resistance in series with the meter when measuring voltage, and in parallel with it when measuring current. Resistance itself can be measured by including a battery in the instrument and measuring the resulting current flow through the un-

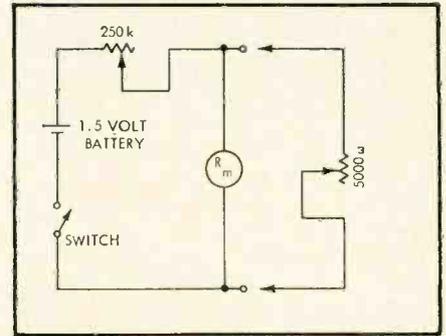


Fig. 3. The meter resistance R_m is equal to the resistance of the 5k pot when the meter deflection is reduced to one half full scale.

known resistance. The calibrating resistors required to convert the meter movement into these useful instruments can be calculated after the meter characteristics are determined.

Meter Characteristics

The two meter movement characteristics which are of interest are the full-scale deflection current, I_m , and the internal resistance of the coil, R_m . A third characteristic, the voltage V_m across the coil at full scale deflection, can be determined from the other two with Ohm's law:

$$V_m = I_m R_m.$$

One or two of these values may be printed on the meter face; if not, they can all be determined experimentally.

The full-scale meter current I_m is found with the use of another ammeter, connected as shown in Fig. 2. The 50k-ohm pot is set to maximum and the 5k-ohm pot to zero before closing the switch. Next the 5k-ohm pot is slowly adjusted until the meter being tested reads full scale. The meter current, I_m , is then read on the reference meter. The 50k-ohm pot is adjusted only if full scale deflection cannot be obtained on the meter being tested when the 5k-ohm pot is at maximum resistance. Values for I_m of 50 μ A, 200 μ A or 1 mA are typical. An unusual value or a very large value may indicate that the meter has an internal shunt for some special application. Open the meter case and remove the shunt to obtain the greatest sensitivity. For sample calculations later in this article, assume that I_m measured 50 μ A.

The other meter characteristic which must be determined is the internal resistance R_m . One way of measuring this is shown in Fig. 3. The 250k-ohm

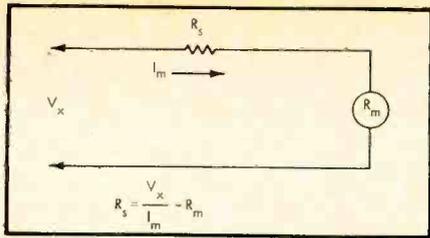


Fig. 4. The voltmeter indicates voltage by measuring the current through a series resistor, R_s .

pot is set to maximum before the switch is closed. It is then adjusted until the meter indicates full scale deflection. Next the 5k-ohm pot is connected in parallel with the meter and adjusted until the meter indicates exactly half scale. The resistance of the 5k-ohm pot now equals the value of the meter resistance, R_m , and may be measured on an ohmmeter or Wheatstone bridge, if one is available. Assume that a value of 1700 ohms is measured.

Having determined the two basic characteristics, I_m and R_m , of the meter movement, it is now possible to design the circuits to convert the meter into a usable instrument.

The Voltmeter

The basic circuit for a voltmeter is shown in Fig. 4, where a resistor R_s is connected in series with the meter and the unknown voltage V_x . The meter indicates voltage by measuring the current in the series circuit. Since this current is directly proportional to the applied voltage in accordance with Ohm's law, the meter face can be calibrated directly in volts. To measure 50 volts full scale, using the 50 μ A meter as an example, the value of R_s is found to be:

$$\begin{aligned} R_s &= (V_x / I_m) - R_m \\ &= (50 / 0.00005) - 1700 \\ &= 1,000,000 - 1,700 \\ &= 998,300 \text{ ohms.} \end{aligned}$$

This value resistor can be made up of two common ten percent tolerance resistors in series, such as 820k and 180k, carefully selected on a Wheatstone bridge.

There are some limitations to this method of measuring voltage which should be considered. First, the lowest voltage which will give full scale deflection is equal to V_m , the voltage across the coil when there is full-scale current, I_m . Again using the 50 μ A meter as an example:

$$\begin{aligned} V_m &= I_m R_m \\ &= 0.00005 \times 1700 \\ &= 0.085 \text{ volts,} \end{aligned}$$

or 85 mv. Secondly, the voltmeter described here will draw the same amount of current from the unknown voltage to obtain full scale deflection on any range. The 50 μ A meter movement will

work perfectly when measuring an automobile battery, for example, but may give completely erroneous results if connected to the base lead in a transistor circuit.

Two ways to avoid loading the circuit being measured are to switch to a higher voltage scale, or to use a more sensitive meter movement. The more sensitive the meter is, the less current it will draw from the source for the same amount of deflection. This sensitivity is commonly expressed in "ohms-per-volt," and is equal to R_m / V_m . Using the same meter as an example:

$$\begin{aligned} \text{Sensitivity} &= R_m / V_m \\ &= 1700 / 0.085 \\ &= 20,000 \text{ ohms/volt.} \end{aligned}$$

Notice that the sensitivity is independent of the series resistance, R_s , but depends only upon the characteristics of the basic meter movement.

When designing a voltmeter for a specific application, a workable procedure

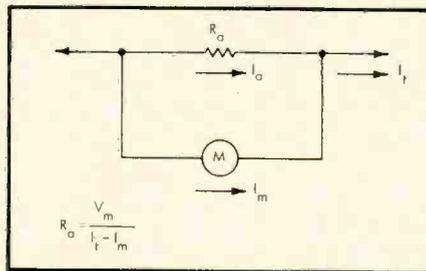


Fig. 5. The ammeter is a current divider which passes I_m through the meter and shunts all the rest of the total current, I_t , through resistor R_a .

is to decide first how much sensitivity is desired, search for a meter from the junkbox which has the required characteristics, select a full scale voltage range, calculate the value of the series resistor R_s for that range and finally, redraw the face of the meter if necessary to show the new range.

The Ammeter

The second instrument which can be constructed with a basic meter movement is the ammeter, the circuit for which is shown in Fig. 5. The shunt resistor, R_s , is selected to bypass almost all of the current, leaving only I_m to flow through the meter. Another way to look at an ammeter is to consider R_s developing a voltage drop equal to V_m at full scale deflection. In either case, the deflection of the meter will be proportional to the total current I_t .

The minimum current which can give full-scale deflection is of course equal to I_m . Thus the current sensitivity of an ammeter is dependent only upon a basic characteristic of the meter movement, and not on the external circuit. The maximum current that can be measured with this simple circuit de-

pends only upon the construction of the test leads and of the shunt resistor R_s .

A problem arises, however, when trying to measure currents much above one ampere because of the small value of R_s required. To measure five amperes, for example, R_s is made equal to:

$$\begin{aligned} R_s &= V_m / (I_t - I_m) \\ &= 0.085 / (5 - 0.00005) \\ &= 0.085 / 5 \text{ (approximately)} \\ &= 0.017 \text{ ohm.} \end{aligned}$$

For home construction this resistor could possibly be made out of Nichrome wire from a discarded electric toaster or iron, but the length of the wire would be critical and its resistance would change appreciably as it was heated by the high current. Some improvement can be gained by using the circuit of Fig. 6, where another resistor, R_b , is connected in series with the meter. If R_b is made equal to the meter resistance, R_m , for example, the value of the shunt resistance, R_a can be doubled. There is a limit to the usefulness of this method, however, because the voltage drop of the completed instrument may become too high for some applications.

When designing an ammeter to measure high currents, it is important to use very large wire for connections to the shunt resistor. It is also better to avoid multiple-range instruments unless a special high-current selector switch is available or unless separate jacks are provided for each range. In addition, it is best to select the basic meter movement with the largest I_m , since this increases R_a to more practical values.

The Ohmmeter

Designing and building an ohmmeter from scratch is more involved than making a simple voltmeter or ammeter, because of the difficulty of marking the meter face for the non-linear resistance scale. If a meter already marked with an ohms scale is available, however, it is a relatively simple task to design a circuit for it.

Figure 7 shows the standard ohmmeter circuit, which is basically the ammeter circuit of Fig. 5 in series with a battery E and a calibrating resistor R_c . The meter indicates resistance by meas-

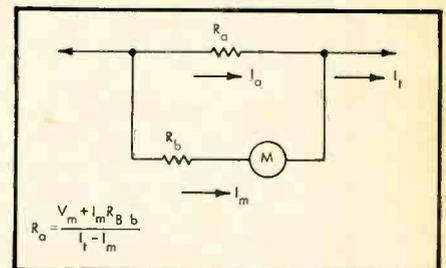


Fig. 6. Modified ammeter allows larger value of R_a by increasing total voltage drop across instrument for full scale deflection.

uring the current flowing in the unknown resistor, R_x .

The key to understanding the operation of an ohmmeter is R_h , the value of R_x which gives half-scale deflection. Consider the circuit of Fig. 7 when all components are adjusted to give full-scale deflection with the test terminals shorted together. Now if the terminals are connected to an unknown resistance and the meter indicates half scale, the unknown resistance must equal the internal resistance of the instrument. This consists of R_1 plus the parallel combination of R_2 and R_m . The meter face can be marked to indicate this value of resistance at the half scale point.

Conversely, if the meter face is already marked with an ohms scale, the value of R_h can be read directly and the ohmmeter circuit designed around it. Assume for example that the mid-scale marking is 15 ohms and that it is desired to calculate R_1 and R_2 for a resistance range of $R \times 100$, using a 1.5 volt battery for E :

$$R_2 = \frac{R_m}{(E/I_m R_h) - 1}$$

$$= \frac{1700}{(1.5/0.00005 \times 15 \times 100) - 1}$$

$$= \frac{1700}{20 - 1}$$

$$= 1700/19$$

$$= 89.5 \text{ ohms}$$

$$R_1 = R_h - \frac{R_m R_2}{R_m + R_2}$$

$$= 1500 - \frac{1700 \times 89.5}{1700 + 89.5}$$

$$= 1500 - \frac{152150}{1789.5}$$

$$= 1500 - 85$$

$$= 1415 \text{ ohms}$$

Values of R_1 and R_2 for other ranges are calculated in the same way.

There are a couple of pitfalls to avoid in this circuit, and it is well to mention them here. Trying to measure very low resistances will cause a heavy current drain from the battery. Using a scale $R \times 0.1$, for example, results in a battery current of:

$$I_b = E/R_h$$

$$= 1.5 / (15 \times 0.1)$$

$$= 1 \text{ ampere,}$$

which is too much to expect of a small flashlight battery, even for short periods of time. In addition, the resistance of the test leads, the selector switch contacts, and even the internal resistance of the battery become significant and must be included as a part of R_x .

At the other extreme, it may be impossible to measure very large resistances with this circuit. The battery current for a range of $R \times 10k$, for example, is:

$$I_b = E/R_h$$

$$= 1.5 / (15 \times 10,000)$$

$$= 0.00001 \text{ ampere,}$$

or 10 μA , which is not enough to give full scale deflection of the meter with

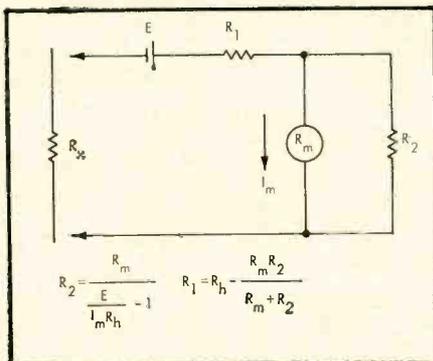


Fig. 7. The ohmmeter indicates resistance by measuring the current through the unknown resistor, R_x .

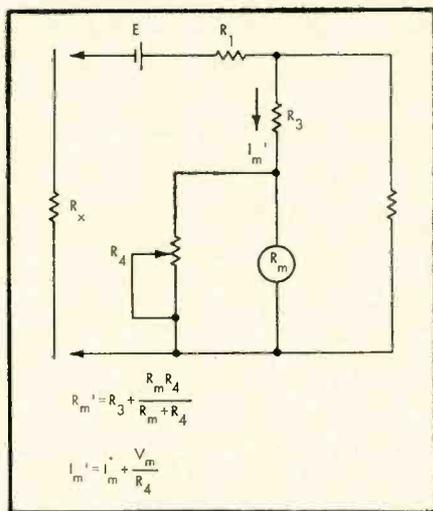


Fig. 8. An improved ohmmeter circuit which compensates for aging batteries with a minimum effect upon R_h . Use R_m' and I_m' in place of R_m and I_m in the equations of Fig. 7.

the test leads shorted. In this case, it will be necessary to use a higher voltage battery, such as a 9-volt transistor radio battery.

There is one serious deficiency with the basic ohmmeter circuit of Fig. 7: the correct meter deflection will be obtained only if the battery voltage is exactly equal to the value of E used in the calculations of R_1 and R_2 . As the battery gradually ages and its voltage decreases, the ohmmeter circuit will tend to indicate more resistance than there actually is. One way to correct for this would be to momentarily short the test probes together and adjust R_1 and R_2 until the meter again reads full scale. In doing this, however, the value of R_h is changed, thus destroying the scale calibration.

A better method is shown in Fig. 8. Here a potentiometer R_4 is connected in parallel with the meter to provide adjustment for aging batteries, and a relatively large resistor R_3 is connected in series with the meter to minimize the effect of R_4 upon R_h . If R_3 is at least ten times R_m , and R_4 is approximately 20 times R_m when set to "zero ohms" or mid position, widely varying battery voltages can be tolerated without greatly affecting the calibration. The same ohmmeter equations are used as before, except that R_m' of Fig. 8 replaces the R_m in Fig. 7. The potentiometer R_4 should be adjusted to give full scale deflection on each range with the test probes shorted together.

Temperature Effects

The use of parallel and series resistors to obtain a special range with a junkbox meter is not without its disadvantages. One of the most serious is that the resulting instrument is likely to be very temperature sensitive. The

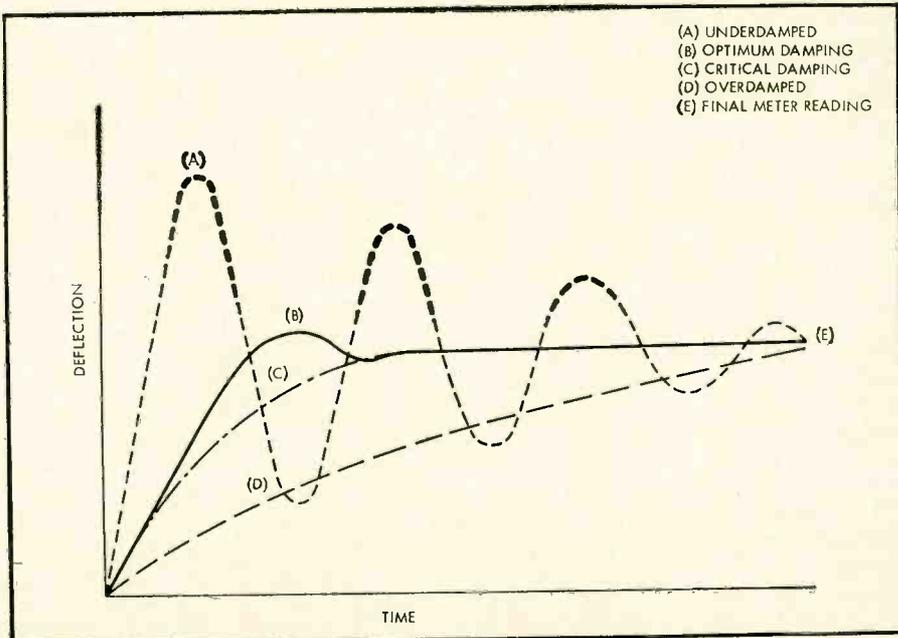


Fig. 9. The effects of various amounts of damping upon meter deflection.

meter coil is made of copper wire, which has a temperature coefficient of 0.0039; that is, its resistance changes approximately 4 per cent for every 10 degrees (Centigrade) temperature change. As long as the instrument is calibrated and used at the same temperature (the accepted standard is 25 deg. C, or 77 deg. F), the reading will be accurate.

If the instrument is calibrated at room temperature and then used outdoors in below-freezing weather, however, serious inaccuracies could result. Meter manufacturers counter this problem by including shunt or series resistors made from a material such as Manganin, an alloy of copper, manganese and nickel which has a temperature coefficient of only 0.000015 per degree Centigrade. In this way the effects of resistance change of the meter coil due to temperature is "swamped," or overshadowed, by the much smaller change of a larger series resistor or a smaller parallel resistor. The home experimenter can only try to calibrate and use the meters at the same temperature, or to use the meter in an application as close as possible to that for which it was designed to take maximum advantage of any built-in temperature compensating resistors.

Damping

The discussion thus far has been restricted to steady-state deflection of a d.c. meter. There are times, however, when the dynamic characteristics of a meter movement become important. Examples would include using the meter in a tachometer where fluctuations of engine speed must be detected, in audio circuits where peaks of signal level must be monitored, or in repetitive measurements where oscillations of the needle seem to take forever to subside.

There are three factors which influence the dynamics, or motion, of a meter movement. They are the moment of inertia, J , the stiffness of suspension, S , and the damping factor DF .

The moment of inertia is a measure of the mass of the moving portion of the meter and its distribution about the axis of rotation. Except for possibly cutting off a portion of the pointer, which is not recommended because it would defeat the purpose of the counterweights built into the suspension, there is usually nothing that can be done to change the moment of inertia of the meter.

The stiffness of suspension is determined by the constants of the restraining spring. This is normally a very delicate device and should not be tampered with. Any attempts to stretch,

bend or shorten the spring usually result in a ruined meter. Don't do it!

The damping of a meter, which is expressed as a number called the damping factor, DF , is a measure of how rapidly the pointer settles to a steady reading after the sudden application of current. The higher the damping factor, the more slowly the pointer moves and the less likely it is to overshoot and oscillate.

The effects of various amounts of damping are shown in Fig. 9. The underdamped condition results in oscillations about the steady state value. The overdamped condition causes the pointer to approach the final reading very slowly. The condition wherein the needle arrives at the steady-state position in the shortest time without overshoot is known as critical damping. Although this is theoretically the optimum damping for a d.c. meter, it has been found in practice more desirable to have a small amount of overshoot, in the order of a few per cent, to give

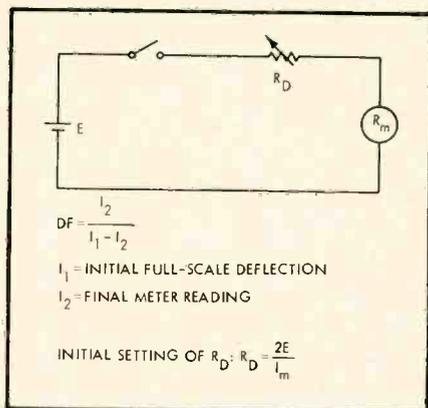


Fig. 10. The damping factor of a meter is the ratio of the final reading to the amount of overshoot.

assurance to the operator that the needle is not sticking in some intermediate position.

Damping is usually provided by the resistance of the air to motion of the meter coil and pointer, and by electromagnetically-induced torques acting upon the coil. In some meters air damping may be augmented by attaching a small metal vane to the coil and enclosing it in a tight-fitting chamber, to act somewhat like the shock absorber on an automobile.

One form of electromagnetic damping is obtained by winding the meter coil upon a lightweight aluminum frame. Eddy currents induced in the frame as it moves through the magnetic field of the meter develop an opposing torque which is proportional to velocity. Neither of these forms of damping is adjustable once the meter is built and they are best left undisturbed.

There is another form of electromagnetic damping, however, which may be varied by the meter user. It is produced when a resistor is connected across the meter terminals to provide a path for currents induced in the coil by its movement in the magnetic field of the meter. The amount of this resistive damping, D_R , is given by:

$$D_R = \frac{K^2}{R_D + R_m}$$

where $K = A$ constant, proportional to the magnetic field and to the size of the coil,

$R_m =$ Resistance of the meter coil, and

$R_D =$ External damping resistor.

The damping factor, DF , is the sum of air damping, eddy current damping and resistive damping. From this relation it is seen that the damping factor may be varied over a limited range by changing the value of R_D , the resistance external to the meter coil.

Since the constant K , and the air and eddy current damping components are not usually known for a surplus meter movement, the damping factor must be determined experimentally. One way of doing this is to measure the overshoot, because it is simply the inverse of the damping factor. A useful circuit for determining percentage overshoot is shown in Fig. 10. The series damping resistor, R_D , is a calibrated potentiometer or resistance substitution box. It is initially set to some high value, such as

$$R_D = \frac{2E}{I_m}$$

which will limit deflection to approximately half scale.

When the switch is closed, the initial needle displacement will be somewhat greater than the final steady-state reading (assuming that the meter is slightly underdamped). The resistor R_D is reduced in steps and the test repeated until the initial displacement is exactly full scale. Then the percentage of overshoot is calculated as the ratio of the difference between the initial and steady-state deflections to the steady-state reading, and the damping factor is found as the inverse of the percentage of overshoot. For example, one meter tested had a final reading of 11.9 mA after an initial full scale deflection of 15 mA. The percentage overshoot is found to be:

$$\begin{aligned} \text{Overshoot} &= \frac{15.0 - 11.9}{11.9} \times 100\% \\ &= \frac{3.1}{11.9} \times 100\% \\ &= 26\% \end{aligned}$$

(Continued on page 102)

Simple Transistor Driver for Stereo Headphones

Fred D. Clapp*

This amplifier makes possible stereo headphone listening directly from a preamp or the outputs of a tape recorder.

A NUMBER OF RELATIVELY inexpensive makes of high fidelity stereo headphones now on the market hold forth the promise of a new experience in stereo listening.

Most available stereo headphones are of the dynamic type, actually miniature loudspeakers, and are of correspondingly low impedance. While these are easily driven from the speaker circuits of any hi-fi system, one might question the economics of operating expensive high-powered amplifiers to furnish a milliwatt or so to headphones. Also, many power stages have considerable distortion and hum when operating at the low levels required here so that the result may not be all that is desired. In addition, it would be very convenient to be able to operate directly from the monitor output of high-quality tape recorders or from low-level phono preamplifiers which cannot normally drive such low-impedance circuits. A typical application arises in monitoring a stereo tape machine during recording. The unit described here was designed to fill these requirements.

Output transformers were avoided in the design due to their weight, possible distortion, and cost. Measurements indicated a required current swing of 70 mA peak-to-peak through 4-ohm phones for maximum tolerable volume. This swing is easily handled by small transistors if the voltage drop is kept low enough to prevent exceeding allowable collector power dissipation. Using a three-volt battery, a quiescent current of 35 mA gives a total power dissipation of about 100 mw, a value easily handled by a 2N214 with its collector rating of 180 mw. Almost any junction type of similar or larger ratings could be used.

A direct-coupled amplifier using another 2N214 was used ahead of the output stage to provide sufficient gain and input impedance to operate from an Ampex 960 monitor jack output. Individual gain controls are provided at

each input to accommodate various sources and for balancing purposes. An input of 100 mv will overdrive the output stage with the gain full on.

The components are assembled on a small terminal board mounted in an aluminum chassis about 4 x 6 x 2 inches, complete with two size "D" flashlight cells for power. The total current of about 70 mA for both channels is too high for penlite cells if reasonable life is to be expected.

Since the circuit is direct-coupled, bias on the input stage is critical for maximum undistorted output to be obtained. Due to normal tolerances of resistors and transistors, it is best to set the value of R_x for best operation using an oscilloscope. Using any convenient sine wave source of a few volts, such as a filament transformer, connect the oscilloscope across the headphone connections of the circuit to be measured, increase the gain control of that circuit from zero until the waveform seen in the scope begins to clip. R_x can then be trimmed slightly so that the clipping is symmetrical on both sides of the wave as the gain is advanced. If de-

sired, a small potentiometer, 150k or so, could be used in place of R_x and locked in place permanently as described above. However little difficulty was experienced in adjusting R_x with suitable series or shunt resistors to the correct value.

The unit described will operate several pairs of headphones if the units are placed in series on each channel. The output is crisp and clean with all the volume one can stand before distortion becomes noticeable. Frequency response is mainly determined by the output coupling capacitor and the 500 μ f unit specified falls off appreciably at 60 cycles with 4-ohm phones. It could be increased to 1000 μ f or more if greater low-frequency response is desired. Since the phones are usually good to about 40 or 50 cycles a 1000 μ f unit would be best. The value given is adequate for phones of 8 ohms or more.

The addition of one more a.c.-coupled stage at the input would provide sufficient gain to operate directly from a low-level phono pickup. This would provide almost the ultimate in economy for stereo listening. AE

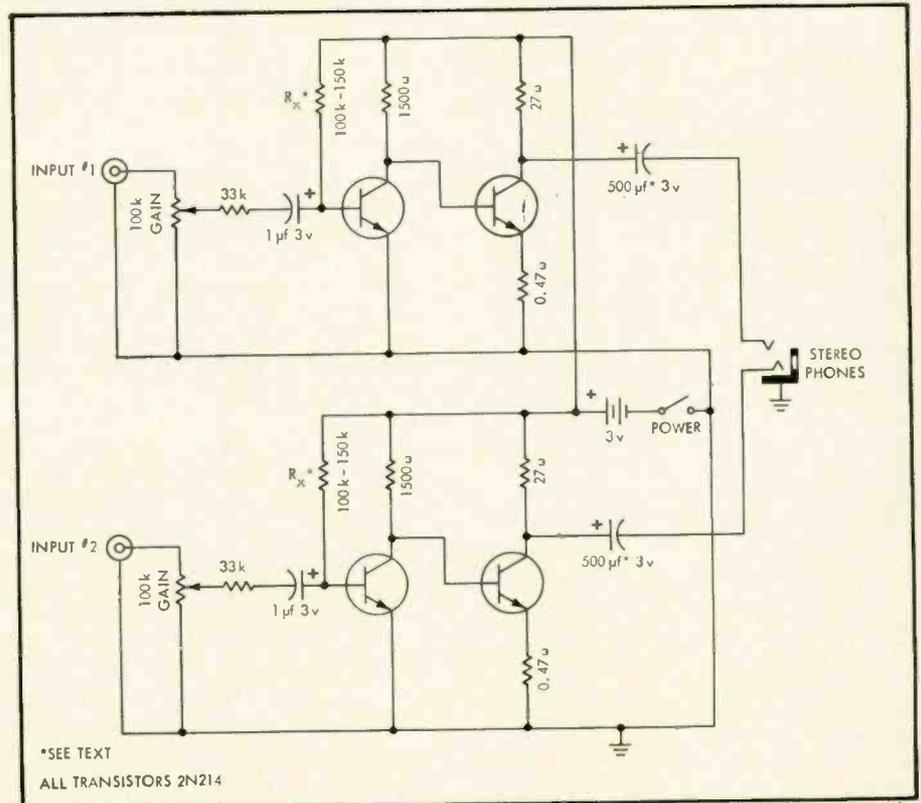
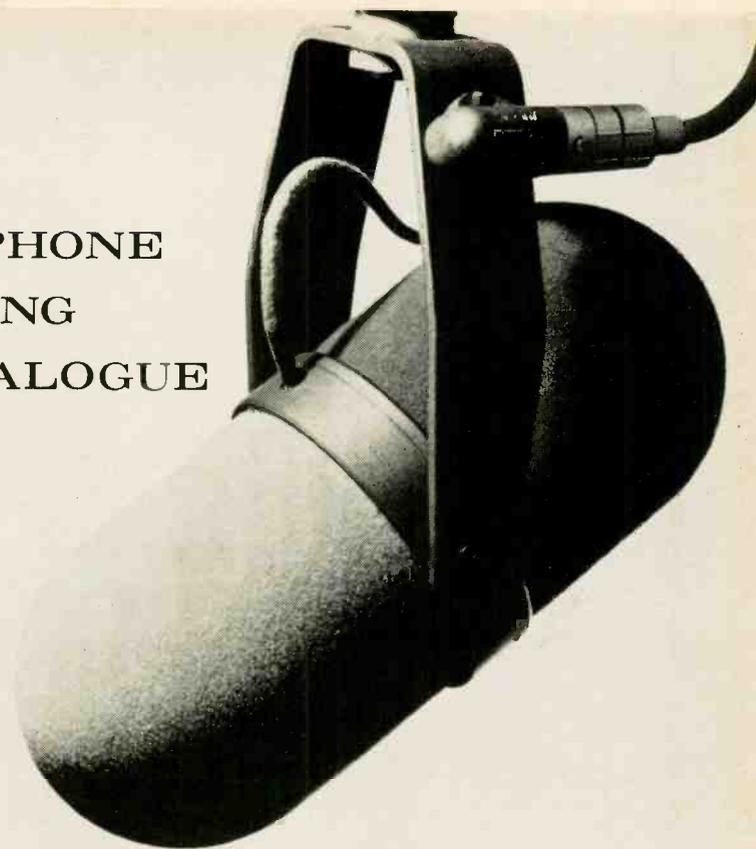


Fig. 1. Schematic of headphone amplifier.

*5610 Castle Dr., Oakland, California 94611

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IGNORES EVERYTHING
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Consistency of sound track quality on an endless variety of locations and sets can be dramatically improved with the remarkable Shure SM5 Boom Microphone. It "hears" the dialogue rather than the ever-changing character of the surroundings.

Because its cardioid directional pattern is uniquely uniform with frequency and symmetrical about its axis, the SM5 is singularly independent of the effects of environment. Even in extreme shooting situations (such as with tight sets, low ceilings, hard walls, low microphone angles, traffic or air conditioner noise and rumble, and changing distance) the SM5 minimizes sound coloration and ambient noise pickup. Equalization

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The highly effective attached windscreen completely encloses the two-stage mechanical filter, so that there are no external "rubber bands" for the wind to "strum." The absence of response-correcting inductors or impedance transformers assures freedom from hum.

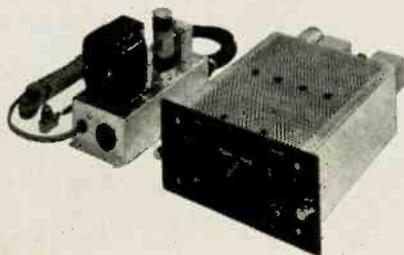
Call on the Shure SM5 to solve your most annoying boom problems!

For additional information, write directly to Mr. Robert Carr, Manager of Professional Products Division, Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois.

SHURE SM5

UNIDIRECTIONAL DYNAMIC BOOM MICROPHONE

SHURE STATION-TESTED AUDIO CIRCUITRY EQUIPMENT



Shure stereo equalizer and preamplifiers are praised as MAJOR contributions to upgrading station quality by broadcasters.

SE-1 Stereo Transcription Preamplifier

Provides precise RIAA equalization from magnetic phono reproducers at line levels. Separate high and low frequency response trimmers. Lowest distortion, noise level, susceptibility to stray RF fields.

M66 Broadcast Stereo Equalizer

Passive equalizer compensates recorded frequency to three playback characteristics: RIAA, flat, roll-off. Provides precise equalization from magnetic pickup at microphone input level.



Circle 115 on Reader Service Card

SOUND and SIGHT

HAROLD D. WEILER

The imminent arrival on the home entertainment scene of the video tape recorder, together with increased interest in 8-mm sound movies resulting from the improved picture quality of Super-8 makes it incumbent on AUDIO to acknowledge these fields. Another area of audio activity that has been slighted is the Audio-Visual. But in SOUND and SIGHT, we will cover all these, with full recognition of the order of importance indicated by the title.

Home motion pictures are only a small segment of a comparatively new and blossoming industry which we feel will be of interest to our readers since "sound" and magnetic recording are to a large degree responsible for its rapid growth. Far from being merely an entertainment medium, motion pictures are employed in many different fields. The combination of sound, motion, and color is today recognized by business, science, education, government, industry, and religion as the most effective means of transmitting information. The medium's effectiveness in any of the varied tasks assigned to it has been proven. It is used to analyze, to report, to educate, to persuade, and to sell.

Selling a physically large system such as the Barry Hyman Company's "Hy-Clip" selective paper conveyor presented problems which were almost insurmountable. Highly trained sales engineers were required to provide detailed, complicated descriptions and explanations, and to show photographs. How would you present this product?

A simple and effective method was devised by Barry Hyman, the president of the company. He used a color sound movie which he made himself. The movie covered the subject thoroughly, with no omissions of important sales points regardless of the capability of the individual salesman making the call. The same complete presentation is made each time in its most effective form.

Barry Hyman says, "This Kodak projector has helped me make sales directly and indirectly. Our paper handling system could not possibly be described properly through any other medium than a sound movie. (The equipment is compact and easy to operate, maintenance is nil, and it

Fig. 2 Using the film as a sales tool.



travels ruggedly in an automobile trunk.) It is a very effective sales tool." This is only one of the many and varied applications of low-cost sound movies in industry and business.

Most of our readers are no doubt aware that three sizes of motion picture film are in general use today. The 35-mm size is usually employed only for entertainment and commercial showings to large audiences, since both the film and the necessary equipment, cameras, projectors and so on are extremely expensive. The optical sound track generally used provides excellent reproduction.

The second size, 16-mm, was considered the amateur film until World War II and the new techniques and improvements it created. Due to these advances and the fact that 16-mm equipment is considerably less expensive, less bulky, and much less complicated than 35-mm equipment, it became the standard for Audio-Visual presentations and in its more advanced forms was found acceptable for TV reproduction. The 16-mm size provides excellent pictures for smaller audiences and for TV use.

One of the greatest problems besetting the early users of 16-mm for educational and industrial purposes was that many of the techniques commonly used with the larger format were not available to the 16-mm filmer, since the necessary accessories were not manufactured. However, the accelerated use of 16-mm film in the Audio-Visual field made further improvements economically feasible. Finally a point was reached where any task which could be accomplished with 35-mm film

could also be done with the smaller size.

The third size is the conventional 8-mm film generally employed for home movies. It has become extremely popular since it provides excellent results for small home audiences who view the film in darkened rooms. The magnetic sound was adequate for narration and simple background music, and most important, the cost of filming was approximately one third that of 16-mm movies.

As the hobby of making home movies grows (there are over seven million 8-mm cameras in use today) the hobbyists increase their skills and seek more sophisticated equipment. The industry met the demand with many refinements and today 8-mm cameras and sound projectors incorporate every feature found in 16-mm equipment, and the large demand caused new and better color film to be introduced.

History then repeated itself! These technical advances combined with the fact that the 8-mm equipment is, in turn, much lighter, less bulky, less complicated, and much less costly than 16-mm equipment resulted in a tremendous interest in this size by educators, industry, science, business, and TV. However, due to the small physical size of the images on the film, its applications were limited.

The recent introduction of Kodak's Instamatic Super 8 Movie System has radically altered this situation. It removes the limitations which precluded the use of 8-mm motion pictures by its many prospective buyers. The new system provides larger, brighter, sharper, steadier pictures. Most important, it allows *prints* of acceptable sharpness, an absolute necessity for most commercial and educational applications. This combination of advances allows the use of sound and color motion pictures in many applications where the budget would not accept 16-mm, and the quality considerations would not accept 8-mm. In addition, the cost of Super 8 equipment is little higher than conventional 8, well within the budgets of even the smallest organizations.

Economy, reduced size and weight, and increased efficiency are not the only reasons we feel this system will revolutionize the Audio-Visual field. Complete automation in filming, recording, and projection make it possible for anyone to produce motion

(Continued on page 98)

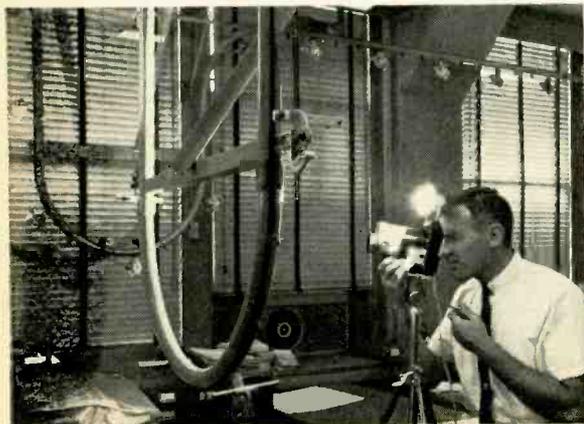
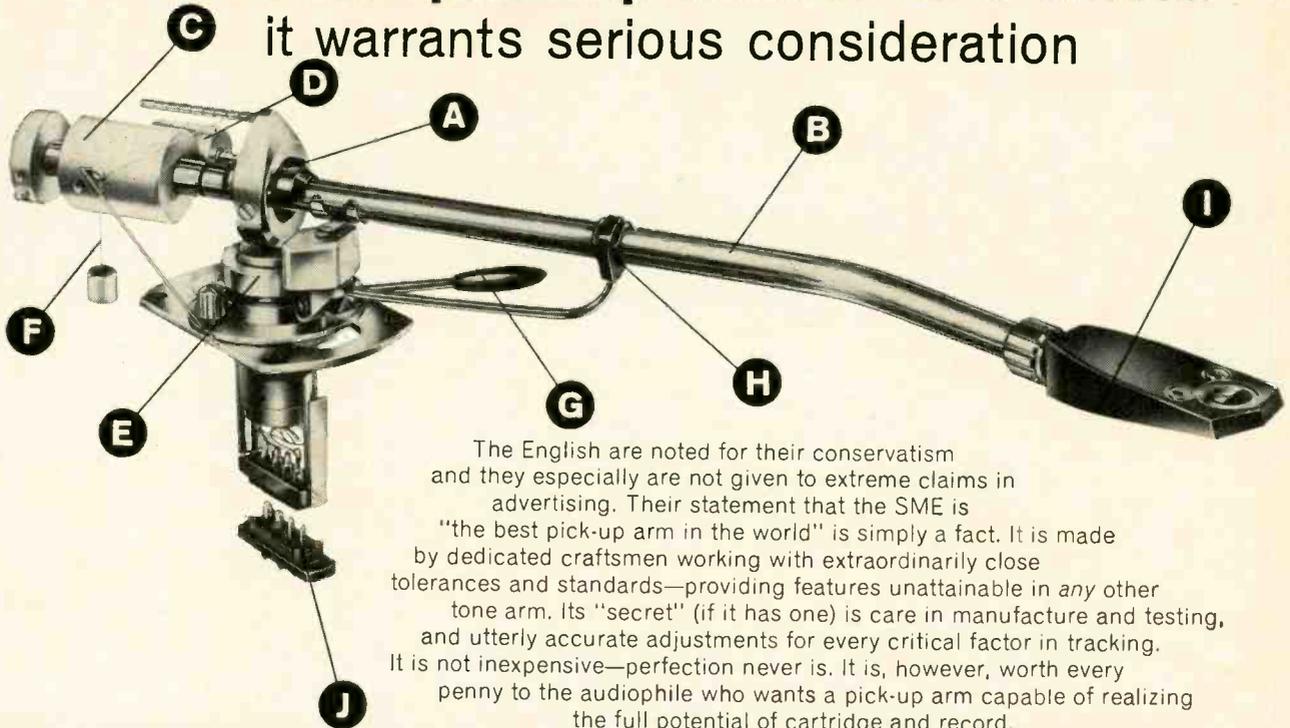


Fig. 1. Mr. Hyman "shooting" the picture.

when the British say
“the best pick-up arm in the world”
 it warrants serious consideration



The English are noted for their conservatism and they especially are not given to extreme claims in advertising. Their statement that the SME is “the best pick-up arm in the world” is simply a fact. It is made by dedicated craftsmen working with extraordinarily close tolerances and standards—providing features unattainable in any other tone arm. Its “secret” (if it has one) is care in manufacture and testing, and utterly accurate adjustments for every critical factor in tracking. It is not inexpensive—perfection never is. It is, however, worth every penny to the audiophile who wants a pick-up arm capable of realizing the full potential of cartridge and record.

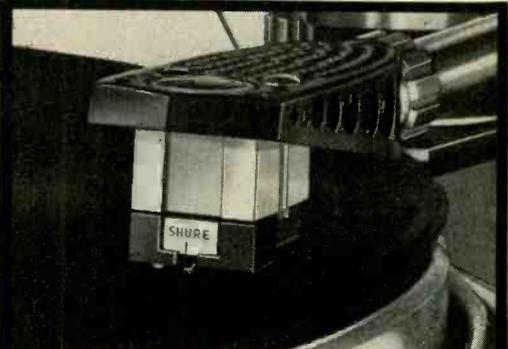
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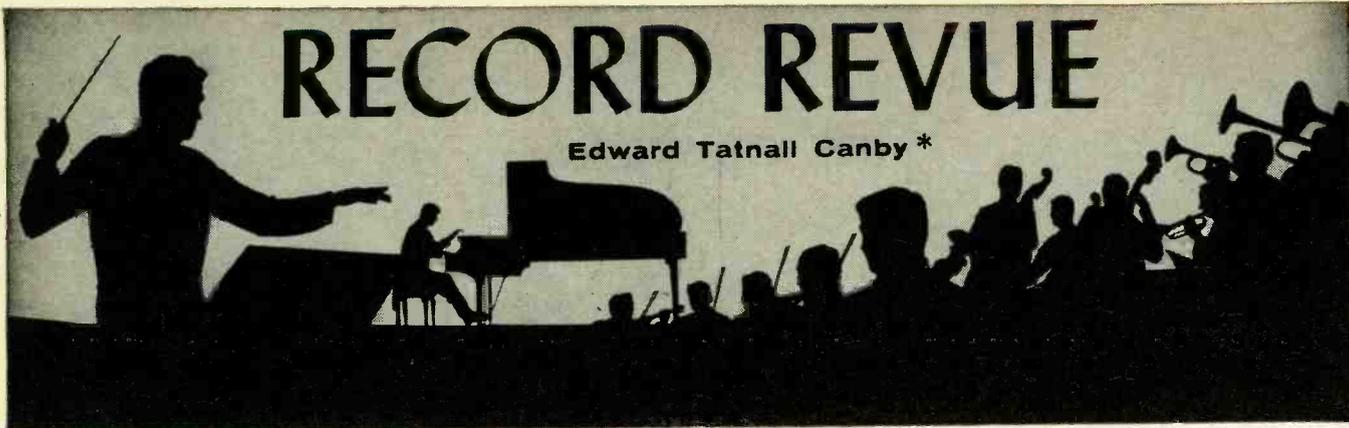
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SHURE BROTHERS, INC., 222 HARTREY AVE., EVANSTON, ILLINOIS

RECORD REVUE

Edward Tatnall Canby *



Midsummer Browse

Schumann: Symphony No. 2 Genoveva Overture. Berlin Philharmonic, Kubelik

Deutsche Grammophon 138955

This is a splendid Schumann recording both technically and in the performance. Kubelik, the Czech conductor, did not do too well in his stay hereabouts (he had the Chicago Symphony for awhile)—more fool us; for he is one of the few really natural Romantic conductors of a middle generation, who can make an orchestra “emote” in the old Nineteenth century manner without either pushing too hard or pounding. This long, utterly Romantic symphony flows as easily as so much breath, vividly alive everywhere and entirely unselfconscious.

The stereo sound is a fine example of the best European-style stereo, probably made via the M-S technique, or crossed-mike, all from a single point. From our American view it is a little old-fashioned, somewhat distant, and the details are placed back a good ways into the echo—but after awhile one gets used to the effect, and a transparency of texture comes through which becomes increasingly fascinating in musical terms. There’s some particularly nice *pianissimo* very low bass, from the string bass section, at the beginning, and a solid bass “feel” throughout, both loud and soft.

The rarely heard overture to Schumann’s opera “Genoveva” (who’s ever heard *that*?) is a happy addition to the symphony, just right for Kubelik’s easy Romantic treatment.

See also several other DGG discs of Schumann in this same series.

Grieg: Cello Sonata in A Minor, Op. 36. Schubert: Cello Sonata in A Minor (“Arpeggione”). Paul Olefsky, cello; Walter Hauzig, pf.

Vox STPL 512.890 stereo

This one ought to be much better than it is in effect, what with two enterprising young soloists, a big piece by Grieg and a sure-fire Schubert to go along with it. Much of the lack of impact is in the recording.

Its sound is curiously lack-lustre, like

music through blankets. Don’t know whether this is its very first release but, stereo or no, the impact is mostly minus. The stereo effect is barely distinguishable from mono, where stereo could do so much for piano breadth and for cello realism.

As for the music, the big Grieg is that same showy, rather outdated piece that Grieg wrote over and over again, the best of them being the famous Piano Concerto. This one gets pretty corny, if with the most serious of intentions. The Schubert is a gem, but not his most profound stuff. The two performers are full of energy (through the sonic blankets), but routine on a high level, the cellist playing typical cellist’s out-of-tune high notes, the pianist lusty and gusty but not very subtle. As I say—it ought to be much a better disc than it actually is. Don’t ask me why.

Twentieth Century Wind Music. (French). Vienna Symphony Woodwinds.

Westminster WST-17097 stereo

Brash Westminster, tossing four French pieces, of the utmost Frenchness, to an Austrian woodwind group! But it works fine and one would hardly know, most of the time.

Poulenc, Roussel, Françaix and Ibert are here represented and only in the noisier parts of the Poulenc—typically contrasted with schmaltzy sentimental tune-stuff—do the Viennese musicians seem a bit confused by it all. The rest is really excellent. Poulenc’s Sextuor is that raggy mixture of moonish sentiment and raffish dissonance that he loved so much, and which concealed all manner of subtleties and tricks of fine repute. Roussel’s little *Divertissement*, Opus 6, is earlier, and impressionist with a touch of acid. Françaix’ Quintet is even sassier than Poulenc, and the three little “*Pièces Brèves*” of Ibert are a frothy dessert. A fine woodwind disc, full of nicely chortling sound effects.

Prokofieff and Rachmaninoff—Their Stories and Their Music. Narr. Arthur Hannes.

Vox MM 3690 mono

Just about the first records on the Vox label years ago in the 78 rpm era were the “*Story and Music*” albums, education-

al discs nominally for children. These present versions are, of course, much longer in the play and more leisurely, as befits the far more useful LP format. The series must be a gas (a success, to you)—26 composers have so far been accommodated in the present catalogue of LPs.

These discussions are pleasant, innocuous, uncontroversial and they don’t do the music any great harm—which is important. (There are similar recordings today which virtually destroy the effect of the very music they are supposedly extolling, by arbitrary fade-outs, clippings, haphazard selection of samples “by the yard” without regard to musical sense.) Vox uses the music conventionally, if carefully, mainly as background and bridge music for the life history, with only an occasional direct reference to the work that is playing. Still—at least the kids hear it, and maybe absorb a few themes and such while listening to the story. No harm done.

Two Twentieth Century Masterpieces — Barber/Hindemith Violin Concerto. Isaac Stern; N.Y. Philharmonic, Bernstein.

Columbia MS 6713 stereo

Well, one of ‘em is, at any rate. I found Mr. Barber’s concerto rather a chore in the listening, for it is one of those difficult pieces which really want to be old-fashioned Romantic and are—yet must try ever so hard to be a bit modern now and then. If the music had a more positive and outgoing quality, it might carry this off; but as it is, the thing seems oddly apologetic, as though to say I know I’m old fashioned but I can’t help it and I’ll try not to be. All of which is merely superficial analysis—I still didn’t much enjoy the thing. And Stern keeps playing it slightly out of tune. Which is rare for him, all right.

Hindemith was an enormous relief afterwards. His concerto, too, is post-Romantic in style, a big piece for a fancy fiddler and a big orchestra. But his style is so outgoing and positive, so positively bustling with confidence and so utterly consistent in every aspect, that you are bowled over by it. Even the typical Hindemith effects—all his music has them—don’t detract. And Stern, after a somewhat tentative opening, gets carried along by this piece. He plays superbly and in tune too.

Guts.

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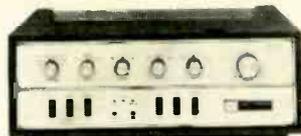
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AMPLIFIERS, Basic and Integrated - 1



ACOUSTECH V



FISHER TX200



BOGEN AT400



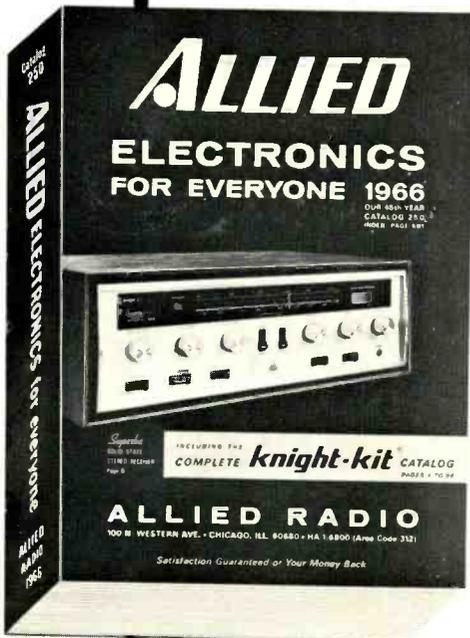
DYNAKIT 70

MANUFACTURER	MODEL NO.	IHF power, w/db		RMS power, w/ch		THD, full power		IM, full power		Power bandwidth	Freq. resp., 1 w	Hum & noise, db below rated output	Input Sensitivity			Output impedances	Damping factor	Headphone Jack Imp	Dimensions			Price	NOTES
		0.25	0.45	0.25	0.45	10%	1%	Phono, mv	Tape head, mv				High level, v.	Width, in.	Depth, in.				Height, in.	Weight, lbs.			
ACOUSTECH	IA	40	0.25	0.45	20-20k	3-100k	85	-	-	4-16	35	-	15%	12	5	29	395.00	Basic pwr amp s/s					
	III	40	0.25	0.45	20-20k	3-100k	85	-	-	4-16	35	-	15	8	5	22	199.00 274.00	Kit } Basic pwr Wired } amp, s/s					
	V	30	0.25	0.45	20-20k	3-100k	85	2.0	-	0.35	4-16	35	yes	15%	12	5	25	349.00	Integ. amp, s/s				
ALTEC	360B	35	25	0.5	13-30k	20-22k	1	4.0	1.9	4,8,16	10	yes	15	11%	5 1/2	24		Integ stereo amp s/s					
	351B	50	40	1.5	25-10k	20-20k	1	90	-	0.45	4,8,16 70 v.	7.5	no	9%	9 1/2	5	15		Basic mono amp s/s				
BOGEN	AP35	17.5	15	0.7 0.5	30-18k	20-30k	70	3.5 35	3.5	0.25	8,16	20	yes	15	10%	4 1/2	16		Integ amp, s/s				
	AT400	15	20	1.0 0.6	20-15k	15-45k	75	3.0 50	3.0	0.2	4,8,16	35	yes	15	9%	3 1/2	12		Integ amp, s/s				
	AT600	30	25	0.6 0.4	20-20k	10-40k	80	2.5 60	2.0	0.2	4,8,16	40	yes	15	10	4%	15		Integ amp, s/s				
CROWN International	SA 20	30	20	0.2 0.2	10-50k	10-50k	67	-	-	0.6	4,8,16	over 200	no	19	8	1 1/2	7 1/2	145.00	Basic mono amp				
	SA20-20	30	20	0.2 0.2	10-50k	10-50k	67	-	-	0.6	4,8,16	over 200	no	19	8	1 1/2	7 1/2	199.00	Basic stereo amp				
DYNACO	Mark 3	60	1.0 .05	1.0 .05	20-20k	6-60k	75	-	-	1.6	4,8,16	15	-	9	9	7	28	79.95 99.95	Kit } Pwr amp, Wired } mono				
	Mark 4	40	1.0 .05	1.0 .05	20-20k	10-40k	76	-	-	1.35	4,8,16	15	-	14	5	7	20	59.95 79.95	Kit } Pwr amp, Wired } mono				
	Stereo 70	45	35	1.0 .05	20-20k	10-40k	75	-	-	1.3	4,8,16	15	-	13	9 1/2	6 1/2	32	99.95 129.95	Kit } Pwr amp, Wired } stereo				
	Stereo 35	23	17.5	1.0 0.1	20-20k	10-40k	72	-	-	1.0	8,16	10	-	13	5 1/2	4	16	59.95 79.95	Kit } Pwr amp, Wired } stereo				
	SCA-35	23	17.5	1.0 0.2	20-20k	20-20k	72	4.0	2.5	1.0	8,16	10	-	13 1/2	4 1/2	10	20	99.95 139.95	Kit } Integ amp Wired } stereo				
EICO	ST70	40	1.0	1.0	10-50k	0.5							no	15%	15	5 1/2	44	79.95 129.95	Kit Wired				
ELECTRO-VOICE	EV1144	25	17	1.0 0.5	1.5	1.0	20-50k	1.5	70	3.5 50	0.6	4-16	35	yes	8%	10	3 1/2	9	124.50	Integ amp, s/s			
ERIC	S40P	10													10 1/2	7	2 1/2	89.00	s/s. Guar. for life				
FISHER	X-100-C	25	24	0.5 0.1	0.5 0.15	25-40k	20-20k	80	3.5 200	2.0	0.32	4,8,16	10	yes	15%	11 1/2	4 1/2	23	169.50	Ctr. chan. spkr out; 2-pos spkr switch			
	X-202-C	42	35	0.5 0.1	0.4 0.1	22-45k	20-20k	80	3.5 200	2.0	0.265	4,8,16	10	yes	15%	11 1/2	4 1/2	30	249.50	Imp. sel. switch; mic input; level sets			
	TX-200	45	35	0.5	0.5	12-50k	20-22k	80	4.0 150	2.6	0.28	4,8,16	20	yes	15%	11 1/2	4 1/2	22	279.50	2-pos. mon. spkr. sw. Sp-Exp jack; tape jk			
	TX-300	50	36	0.5	0.5	12-50k	20-25k	86	2.3 150	1.8	0.2	4,8,16	20	yes	15%	11 1/2	4 1/2	24	329.50	Direct tape monitor; 4-pos spkr switch			
	SA-1000	75	65	0.25 0.1	0.4 0.1	12-45k	5-100k	90	2.5 2.0				4,8,16	17	no	15%	12	7 1/2	71	329.50	Freq-comp. input att.		

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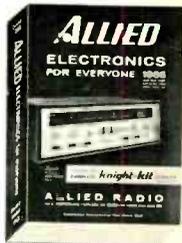
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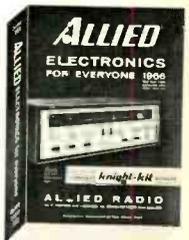
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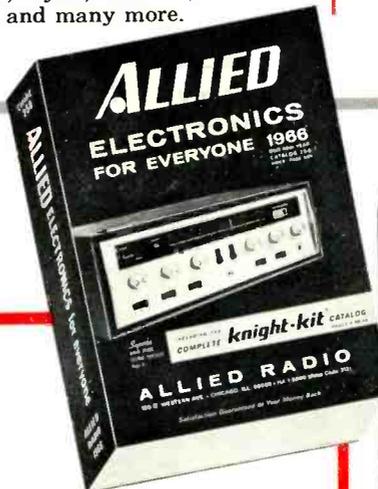
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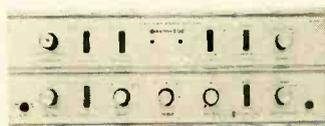
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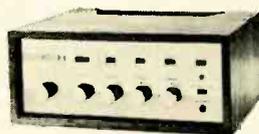
AMPLIFIERS—Basic and Integrated-3



KNIGHT KG895



KENWOOD TK 400



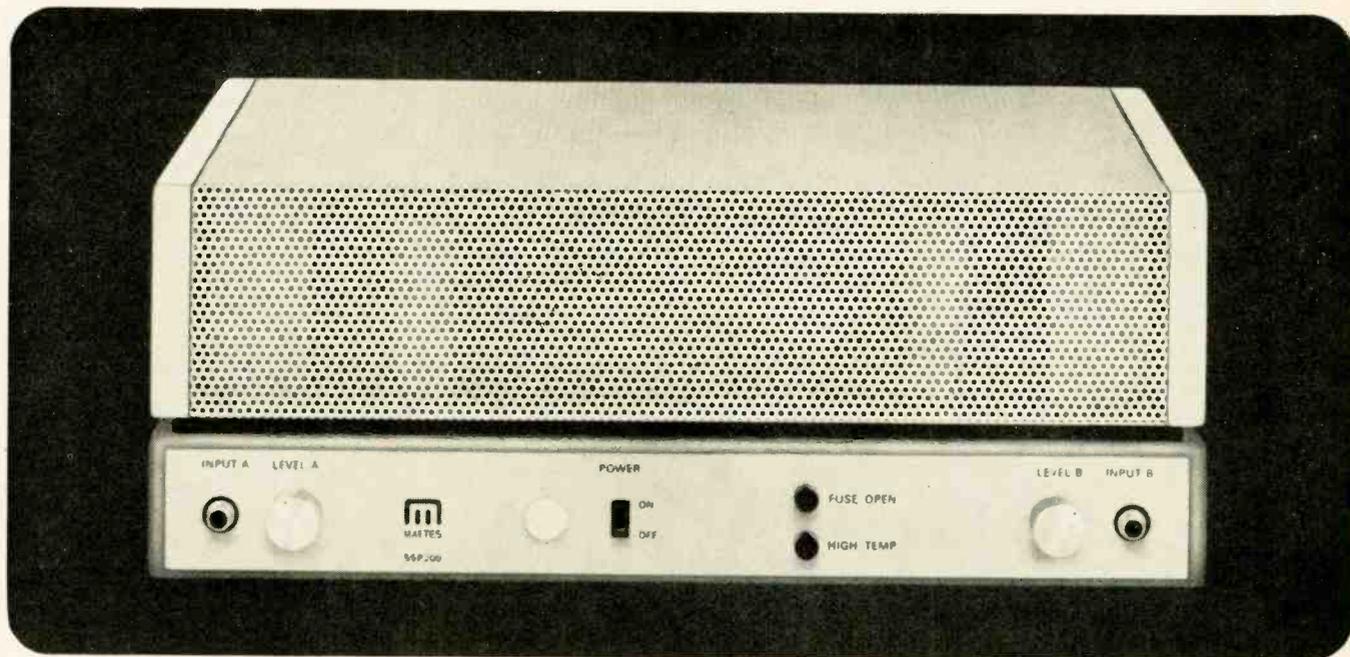
KLH MODEL 16



LAFAYETTE LA-248

MANUFACTURER	MODEL NO.	IHF power, w/ch		RMS power, w/ch		THD%, full power		IM%, full power		Power bandw/dth	Freq. resp., J, w		Hum & noise, db below rated output		Pilotage, mv overload, mv		Tape head, mv		High level, v.		Output impedances		Damping factor		Headphone jack imp		Dimensions			Price	NOTES
		1	2	1	2	1	2	1	2		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±		
KNIGHT-KIT	KG-895	60	40	0.5 0.3	1.0 0.7	20-20k	18-30k 1	75	2.5	2.0	0.25	4,8,16	6 11	yes low	16%	15	5	28	149.95	s/s kit											
	KG-870	35	28	0.5 0.3	1.0 0.7	25-18k	20-25k 1	80	3.0	2.0	1.0	8,16	12.5 17.5	yes low	13	11	2 1/2	15	99.95	s/s kit											
	KG-320	16	10	1.0 0.7	1.5 0.8		25-18k 1	75	3.0	2.5	0.4	8,16		-	10	8 1/2	2 1/4	9	59.95	s/s kit											
	KG-400	19.5	16	1.0 0.5	1.5 0.35	35-15k	30-16k 1	75	2.0	2.0	0.2	4,8,16		-	13%	11 1/4	4 1/4	18	59.95	Tube type kit; ctr. ch output for 8,16 ohms											
	KG-240	10	8	1.5			35-15k	60	cer 500	no	0.5	8,16			10	7	5	11	27.95	Upright tube type kit											
LAFAYETTE	LA-248	25	20	0.7 0.3		50-25k	20-20k 1	70	1.4 65	2.7	0.85	4,8,16		yes 8	13%	9 1/4	4 1/4	18	119.50	s/s; spkr phase sw; 2 AC outlets											
	LA-350	35	28	1.0 0.2		50-27k	15-30k 1	65	6.0 160	1.5	0.1/ 0.75	8-16	53	yes 8	14%	10%	5 1/4	30	99.50	Spkr phase sw; tape monitor											
	LA-224A	18	15	1.25 0.25		60-27k	40-25k 1	75	5.5 130	-	0.6	8-16	20	yes 8	14%	10%	4 1/4	20	59.95	Spkr phase sw; rumble filter											
	LA-340	20	12	1.0		70-27k	30-20k	56	2.0	2.5	0.25	4,8,16		yes	11%	8 1/4	3 1/4	10	79.95	Tape rec output; 2 AC outlets											
LANSING (JBL)	SE400		40	0.25 0.18	1.0 0.5	10-30k	3-60k 3	79	-	-	3.0	4 to 16	var	-	15%	6%	4%	22	261.00	Plug-in board matchline amp, to specific spkr											
	SA600		40	0.25 0.18	1.0 0.5	10-30k	3-60k 3	79	5.0 200	5.0	0.25	4 to 16		yes	16%	13 1/2	5 1/4	27	300.00	s/s stereo integ amp											
LEAK	Stereo 20	20	11	0.1			20-20k 0.5	80	-	-	0.125/ 1.0	4,8,16	25		10 1/2	12 1/4	6%	2 1/2	149.00	Basic stereo amp											
	Stereo 60	60	30	0.1			20-20k 0.5	80	-	-	0.125/ 1.0	4,8,16	25		10%	13%	6%	2 1/4	219.00	Basic stereo amp											
	TL/50 Plus	100	50	0.1			20-20k 0.5	85	-	-	0.125/ 1.0	4,8,16	15		11 1/2	9	6%	28	159.50	Basic mono amp											
	TL/25 Plus	60	30	0.1			20-20k 0.5	85	-	-	0.125/ 1.0	4,8,16	25		10	7%	6%	17	119.50	Basic mono amp											
	Stereo 30	15	10	0.1			20-20k 0.5	80	-	-	0.125/ 0.25	4,8,16	60		13	4 1/4	9	14	249.50	Integ stereo amp s/s											
LUX	SQ-38D	16	12	0.5 0.3	1.2 0.8	7-20k	5-24k 1	62	2.0	1.2	0.5/ 0.1	4,8,16		no	18 1/2	11 1/4	6%	30		Integ stereo amp Triode output stage											
	SQ-63	16	10	0.9 0.5	1.6 1.1	20-18k	20-22k 1	60	4.0	2.0	0.2	8,16	var	no	15%	11 1/4	6%	22.3		Integ stereo amp notional feedback											
	SQ-77	17	11	1.0 0.7	2.0 1.6	18-20k	15-22k 1	62	4.0	2.0	0.2	8,16		yes 8	13%	8 1/2	5%			Integ stereo amp											
	SQ-5B	20	14	1.0 0.7	2.0 1.6	15-20k	13-22k 1	62	4.0	2.0	0.2	4,8,16,32		no	15%	11 1/4	6%	22.5		Integ stereo amp style as SQ-63											
	MB-8A	100	70	0.3 0.1	1.0 0.3	10-20k	7-22k 1	90	-	-	0.8	4,8,16,32		no	17%	7%	9%	36.8		Basic amp, mono											
MARANTZ	8B		35	.06	0.5	15-40k	2-40k 1	100+	-	-	1.25	4,8,16	20	-	13 1/2	10 1/2	7%	55	285.00	Basic stereo amp											
	9		70	.06	0.5	12-40k	2-40k 1	100+	-	-	1.25	1,4,8,16	17	no					384.00	Basic mono amp Triode sw. for 40 w.											

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Three high-fidelity power amplifiers are demonstrably superior to all others in design and performance. Of the three, two are vacuum-tube amplifiers: while they are similar, each has its partisans. The third amplifier—the Mattes SSP/200—utilizes a new circuit which transistors alone make possible. Because it is remarkably different in design from earlier solid-state amplifiers, the SSP/200 delivers more power at lower distortion than either of the tube amplifiers in the premium class, yet it costs less than either of them.

Readers familiar with older transistor amplifier circuits will readily recognize that conventional solid-state designs do not approach the level of performance of the SSP/200, even when the costliest silicon transistors are employed. Instead, the radically new Sharma Circuit*, developed at Mattes, is used in the SSP/200; rather than depending upon unusual transistors, the Sharma Circuit applies ordinary transistors in a surprising new way. Reprints of the technical articles describing the Sharma Circuit are available from Mattes Electronics; the salient features of the SSP/200 amplifier are as follows:

Power output is 100 watts per channel (rms) to 8-ohm or 4-ohm loads, delivered at any frequency between 20 and 20,000 cycles within 1 dB and with less than 0.5% total harmonic distortion. For those for whom it is meaningful, the "IHF Music Power" is 160 watts per

channel. Intermodulation distortion is well under 0.1% at full output, whether the test frequencies are the standard 60 and 7,000 cps or 20 and 20,000 cps. Accidental short-circuit of the output terminals does not disable the SSP/200. Its stability is unaffected by open-circuit operation or by playing each channel into a 0.5-microfarad capacitor—it is unexcelled as a signal source for electrostatic loudspeakers. The damping factor is greater than 200.

These unusual characteristics permit the SSP/200 to reproduce musical performances at their original acoustic level, even with inefficient loudspeaker systems. It can do this at extremely high levels with insignificant distortion.

All of this is accomplished in a small ($\frac{1}{3}$ cu. ft.), light (27 lbs.), cool unit incorporating such functional refinements as parallel inputs on front and rear panels, and binding-post output terminals spaced for General Radio plugs. A comprehensive description of the SSP/200 can be obtained by visiting a franchised Mattes dealer in your area, or by writing to Mattes Electronics.

Other Mattes advanced solid-state components are to be released shortly.

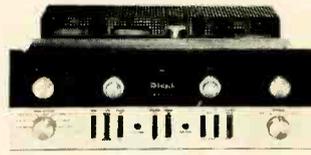
*U.S. and foreign patents pending. The Sharma Circuit is described in *Journal of the A.E.S.*, Vol. XIII, No. 3, July, 1965, and, in less detail, in *Electronics World*, Vol. 73, No. 3, March, 1965.



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MANUFACTURING ENGINEERS/SOLID STATE CIRCUITRY

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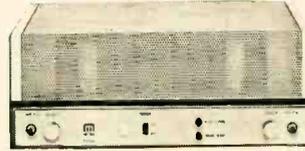
AMPLIFIERS—Basic and Integrated—4



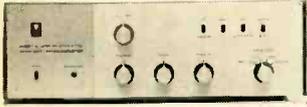
McINTOSH MA230



SCOTT 260



MATTES SSP200



LANSING SA600

MANUFACTURER	MODEL NO.	IHF power, w/ch		RMS power, w/ch		THD _{1%} , full power		IMD _{1%} , full power		Power band, (rth)	Freq. resp., J w	Hum & noise db below rated output	Phono, inv	Tape head, inv	Input Sensitivity		Output impedances	Damping factor	Headphone jack imp	Dimensions			Price	NOTES
		1	2	1	2	1	2	High level, v.	Low level, v.						Width, in.	Depth, in.				Height, in.	Weight, lbs.			
McINTOSH	MC225	39	25	0.5 0.1	0.5 0.1	14-100k	20-20k 0.1	76	-	-	0.5	4,8,16,150 200,600,*	10	no	14½	9	7	34	198.00	Stereo pwr amp or 80-w mono pwr amp				
	MC240	64	40	0.5 0.1	0.5 0.1	10-100k	20-20k 0.1	74	-	-	0.5	4,8,16,125 200,600,*	10	no	17¼	10¾	8	56	288.00	Stereo pwr amp or 80-w mono pwr amp				
	MC275	107	75	0.5	0.5	10-100k	20-20k	72	-	-	0.5	4,8,16,67, 150,600,**	10	no	17¼	12¼	8	67½	444.00	Stereo pwr amp or 150-w mono amp				
	MA230	44	30	0.5 0.1	0.5 0.1	12-40k	20-20k 0.5	76	1.5 150	1.5	0.25	4,8,16	10	yes hi/lo	16	14½	5½	43	349.00	Integ stereo amp; s/s input stgs; tube output				
	MI-200	288	200	1.0 0.1	1.0 0.1	15-60k	20-20k 1	60	-	-	0.5	4,8,16,25 ***	10	no	19	10¾	17¼	140	640.00	Hvy duty pwr amp				
* Also 25-v and 70.7-v line; ** Also 25-v and 70.7-v and 115-v and 230-v line; *** Also 32, 64, 100, and 600 ohms and 25-, 70.7-, 120-, and 141-v line																								
MATTES	SSP/200	160	100	0.5 0.5	0.1 0.3	20-20k	15-30k 1	73	-	-	1.0	4,8/16	250	no	14¼	9	5½	27	375.00	s/s				
PIONEER	SMT-84	45	40	1.0 0.3			10-70k 1	55	2.5	1.5	0.25	8,16		yes 4-16	15	13	5	28		Integ stereo amp s/s				
	SMT-83	40	28	1.0 0.3			15-100k 1	60	3.0	2.0	0.2	8,16	13	yes 4-16	15	13	5	28		Integ stereo amp				
PURE-SONICS	410-C	55	45	.01 .005	.03 .01	30-15k	6-60k 2	90			2.5	4,8,16	200		17	11	5	35	319.00	Stereo power amp				
	250	40	30	.02 .01	.06 .02	30-15k	10-50k 2	80	3.0 30	3.0	0.5	4,8,16	160	yes 8	16	11	5	36	345.00	Integ stereo amp; s/s up to output stage				
QUAD (Acoustical Mfg. Co.)	QUAD II	15	0.1			20-20k	10-50k 0.5	80	-	-	1.4	7,15	10	no	13	4¾	6½	18¼	100.00	Basic mono amp				
SCOTT	260	50	37	0.8 0.25	2.0 0.5	20-20k	15-30k 2	80	3,5,9 23-62	2.0	0.5	4,8,16	20	yes low	15½	13¾	5½	21	259.95	Integ stereo amp s/s Si; ctr. chan. out				
	233	35	28	0.8 0.25	2.0 2.0	25-20k	20-20k 2	80	3,7,22 50,100 1.2	4.5	0.5	4,8,16	10	yes	15½	13¾	5½	31	189.95	Integ stereo amp powered ctr. chan				
SCHOBER ORGAN	TR-2	50	40		1.4 0.9	20-20k	9-40k 1.5	67			.055	4-16		no	5½	11¼	7½	13	69.95	Basic mono amp; avail from mfg only. Kit				
SHERWOOD	S-9000	75	50	0.25 0.1	0.75 0.1	12-25k	10-100k 0.25	75	1.8 40	1.0	0.25	4-16	50	yes 4-16	14	12½	4	24	299.50	Integ stereo amp, s/s powered ctr. chan				
	S-9900	45	36	0.33 0.15	0.75 0.1	12-35k	10-100k 0.25	75	1.4 40	1.0	0.25	4-16	50	yes 4-16	14	10¾	4	22	229.50	Integ stereo amp, s/s powered ctr. chan				
	S-9500	25	18	0.33 0.15	0.75 0.1	12-35k	10-100k 0.25	75	1.4 250	1.0	0.25	4-16	50	yes 4-16	14	10¾	4	20	179.50	Integ stereo amp, s/s powered ctr. chan				
	S-5500 IV	40	30	0.5 0.2	1.0 0.2	35-15k	20-20k 0.25	70	1.5 250	1.8	0.25	4,8,16	15	yes 4-16	14	12¾	4	28	179.50	Integ stereo amp Ctr chan output				

“Until just recently, I have been somewhat skeptical about low priced transistor amplifiers. However, after testing and listening to the Heath AA-22, I feel it is time to revise my opinion. This remarkable amplifier can easily hold its own against any amplifier — tube or transistor — anywhere near its price range.”

JULIAN D. HIRSCH, Hi Fi/Stereo Review, Nov. '64



Heathkit® 40-Watt Transistor Stereo Amplifier \$99⁹⁵!

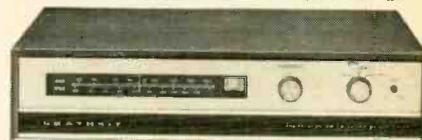
Mr. Hirsch Went On To Say: “It is the embodiment of the so-called ‘transistor sound’ — clean, sharply defined and transparent. It has the unstrained effortless quality that is sometimes found in very powerful tube amplifiers, or in certain expensive transistor amplifiers.” “The AA-22 is almost unique among amplifiers at or near its price, since it delivers more than its rated power over the entire range from 20 to 20,000 cps” “The power response curve of this amplifier is one of the flattest I have ever measured” “Its RIAA phono equalization was one of the most precise I have ever measured” “Intermodulation distortion was about 0.5% up to 10 watts, and only 1% at 38 watts per channel, with both channels driven” “The hum and noise of the amplifier were inaudible” “Hi Fi/Stereo Review’s kit builder reports that the AA-22 kit was above average in ‘buildability’” “In testing the AA-22, I most appreciated not having to handle it with kid

gloves. I operated it at full power for long periods, and frequently overdrove it mercilessly, without damage to the transistors, and with no change in its performance measurements” “One of the best things about the Heath AA-22 is its price, \$99.95 in kit form, complete with cabinet.”

Let’s Look Closer! The AA-22 provides 40 watts continuous, 66 watts IHF music power at ± 1 db from 15 to 30,000 cps. Features 5 stereo inputs to handle mag. phono, stereo-mono tuners, tape recorders, & 2 auxiliary sources. There are 4, 8 & 16 ohm speaker outputs plus tape recorder outputs; a 5-position selector switch; 3 position mode switch; dual-tandem control; bass & treble controls.

Get Full Details Free! Simply use coupon below. Or better yet, order both the AA-22 Amplifier & its matching AJ-33 tuner now! Kit AA-22, Amplifier, 23 lbs. \$99.95

“WILL GET ANY STATION THAT CAN POSSIBLY BE PULLED IN”



Matching AM /FM /FM Stereo Tuner

The above quote comes from July '64 issue of *Radio-Electronics*.

The matching AJ-33 tuner features a built-in stereo demodulator; AGC for steady volume; AFC for drift-free reception; stereo indicator light; stereo phase control for maximum separation, minimum distortion; filtered stereo outputs; tuning meter; flywheel tuning; voltage regulated power supply; illuminated slide-rule dial; and pre-built, prealigned FM “front-end” tuner and AM-FM I.F. circuit board for fast, easy assembly.

Kit AJ-33A, Tuner, 17 lbs. Now Only \$94.50

FREE CATALOG!

See these and over 250 other exciting Heathkits available in easy-to-build kit form. Save 50% or more by doing the easy assembly yourself! Send for your free catalog today!

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Benton Harbor, Michigan 49023
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Enclosed is \$ _____, plus shipping. Please send Kit(s) _____

Please send Free Heathkit Catalog.

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HF-179

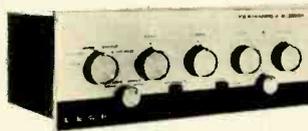
PRODUCT PREVIEW SECTION — PREAMPLIFIERS



ACOUSTECH IV



HEATH AA141



LEAK VARISLOPE 2

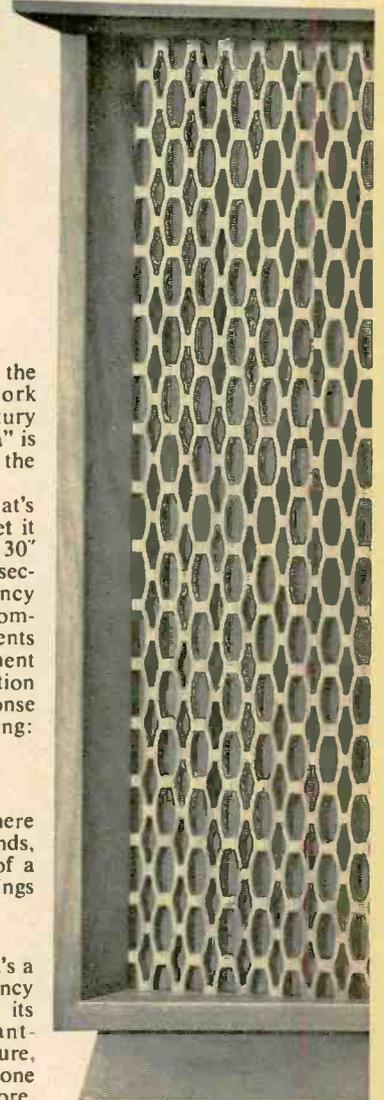


MARANTZ 7

MANUFACTURER	MODEL NO.	Freq. resp. \pm db	Rated output, v.	THD ^{10%} , rated output	IMV ^{10%} , rated output	Hum & noise db below rated output	No. of inputs	Sensitivity, mv	Phono			Tape Head		Tuner		Dimensions				Price	NOTES
									Equalization	Overload, mv	Sensitivity, mv	Equalization	Sensitivity, v.	Other inputs	Tape monitor?	Width, in.	Depth, in.	Height, in.	Weight, lbs.		
ACOUSTECH	IV	3-200k	2.0	0.1	0.09	75	2 mag	2.5 10	RIAA	20 90	- -	.35	aux	yes	15%	8	5	11	149.00	s/s kit	
	VI	3-300k	2.0	0.1	.09	75	2 mag	2.5 10	RIAA	20 90	- -	.35	aux	yes	15%	8	5	12	249.00	s/s	
DYNACO	PAM-1	10-40k 0.5	2.0		0.05		Lo mag Hi mag	3.0 15	RIAA 78	200	3	NAB see	0.2	Hi- phono tape amp TV special	yes	12	6	3	7	34.95k 59.95v	Special input is wired for tape head
	PAS-2	10-40k 0.5	2.0		0.05		Lo mag	2.0	RIAA	125	2	NAB	0.2	Spare special tape amp	yes	13½	4¼	8	11	59.9k 99.95v	Special input is wired for tape head
	PAS-3	10-40k	2.0		0.05		Lo mag	2.0	RIAA	125	2	NAB	0.2	Spare special tape amp	yes	13½	4¼	8	11	69.9k 109.95v	Special input is wired for tape head
FISHER RADIO CORPORATION	400-CX	20-25k 1	2.5	0.04	0.2	75	2 mag 1 cer	1.5 6.0	COL EVR	200	3	NAB 7 3	0.2	aux (2) tape mic	yes	15%	10%	4 1½	18	199.50	Controlled center-channel output; Space-expander and remote-control jacks.
HEATH	AA-141A	20-20k 1	2.5	0.1	0.1	60	mag cer	6.0 200	RIAA			200 mv	aux 1 aux 2	yes	15%	7 1½	5 ¼	8½	34.95		
LEAK	Varislope 2 stereo	20-20k 0.5 db	125mv	0.1		78	1 mag	3.5	RIAA		3	NAB/ CCIR	.05	aux, mike, tape, amp.	yes	10%	6½	3 ¾	6½	129.50	Takes power from any Leak Amplifier
LUX CORPORATION	PZ-21	7-22k	10	0.1	0.8	-60	mag mag tape aux	3 0.3 1 250	RIAA RIAA	30 3 15	1		-	aux	no	15%	11¼	6 ½	20		Sharp low and high cut off filters
	PZ-12	10-25k	2.0	0.3	1.0	-60	mag	3.5	RIAA	10	no	no	no	aux 1 aux 2	no	8%	5 %	2 ¼	2.4		AC or DC use s/s
MARANTZ	7	20-20k ½	10v		0.15	94	mag 2	0.6	RIAA COL LP OLO 78	200	1	NAB 7½	.075	TV tape aux	yes	14% 15%	8½ 5 ¾	15	285.00	Panel size	
McINTOSH LABORATORY INC.	C22	20-20k 0.5	2.5	0.1	0.1	85	mag 2	2	RIAA LP	200	2	NAB adjust- able	0.25	aux tape amp	yes	16	13	5 7/16	16	279.00	Step tone control front panel input for tape dubbing
	C24	20-20k 0.5	2.5	0.1	0.1	85	mag 2	2	RIAA LP	200	2	NAB	0.20	aux tape amp	yes	16	11	5 7/16	17	249.00	s/s
	MX110	20-20k 0.5	3.0	0.2	0.2	85	mag 2	3	RIAA	200	3	NAB		aux	yes	16	13	5 7/16	27½	399.00	Tuner-preamp see H-3 listing
PURE-SONICS INC.	112	5-60k 1	3	.01	.02	80	4 mag 4	3 400	RIAA	100	2	NAB	.5	aux tape record	yes	14	8	5	13	279.00	
QUAD	QUAD 22	20-20k 0.5	1.4	.02	-	70	3	400			4	NAB CCIR	0.07	mic.	no	10%	6	3½	6¾	107.00	Uses plug-in adaptor for tape
RADFORD	SC22	5-100k	2			60	mag	2	RIAA	450			0.1 0.2 0.3	aux	yes	10%	1.2%	3¼	11 lb.	180.00	

WE TOOK ALL THE COMPONENTS OF OUR
FAMOUS A-7 "VOICE OF THE THEATRE"[®]
AND DESIGNED THIS WIFE-PLEASINGLY-
BEAUTIFUL ENCLOSURE FOR THEM.

(Now everyone can have a full-size speaker system!)



We call our new **PLAYBACK** speaker system the "Valencia." That's because its unique fretwork grille design is adapted from a 16th-Century Spanish palace ornamentation. The "Valencia" is so beautiful your wife will want to rearrange the room to show it off!

We call our new "Valencia" fantastic. That's because it measures 29³/₄" x 27¹/₂" x 19"—yet it has all the components of our gigantic, 54" x 30" x 24", A-7! The 15" 416A bass speaker, 811B sectoral horn driven by an 806A high-frequency driver, and 800-cycle dividing network are components of the "Valencia." The same components that have made the huge A-7 standard equipment for broadcast and recording studios and motion picture theatres everywhere. Frequency response of the "Valencia": 30-22,000 cps. Power rating: 30 watts.

**COMPARE THE SOUND OF A SPINET PIANO
TO THAT OF CONCERT GRAND!**

Spinets can be pretty, and they can "fill in" where there's no room for a grand. But the big sounds, the power and majesty, the dynamic range of a Beethoven sonata—these require the long strings and big sounding board of a grand!

THE SAME THING WITH SPEAKERS.

For big sound, you need full-size speakers. It's a matter of physics. The ability of a low-frequency speaker to reproduce low bass is limited by its resonant frequency. When a low-resonant-frequency speaker operates in a small enclosure, the stiffness of the air behind the speaker cone causes a rise in resonance a whole octave or more. Below this resonant point, the response falls off at a rapid rate, 12 db per octave!

**WHAT ABOUT ALL THE PUBLISHED 'TESTS'
WITH LITTLE SPEAKERS?**

Just this—they were all compared with little speakers—*NOT ONE TEST* was matched with a full-size speaker system!!

Reason:—read the full facts from the Great Debate—"Is a Good Big Speaker Better Than a Good Little Speaker?" A copy will be forwarded to you along with information on the new "Valencia."

**"VALENCIA" BRINGS YOU SOUND
WITHOUT COMPROMISE.**

Even if your wife thinks a speaker's beauty is just skin deep! Even if you have just an average-size room! Now you can get the sound that only a full-size speaker system can offer: a meaty, no-distortion sound without compromise!

**HEAR THE 'VALENCIA' AT YOUR
ALTEC DEALER'S NOW!**

Make a real test—A-B it against any other speaker! You won't believe that anything as beautiful as the "Valencia" could sound so impressive! Consumer net. \$333. Write Dept. A-8 for literature.



ALTEC LANSING

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ANAHEIM, CALIFORNIA

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Circle 123 on Reader Service Card

PRODUCT PREVIEW SECTION — *TUNERS-1*



DYNA FM3



EICO ST97



FISHER TFM-200



HARMAN-KARDON ST-2000

MANUFACTURER	MODEL NO.	IMF, usable sens., μv .		Volume sens., μv .		THD%, 100% mod.	Capture ratio, db	Drift, kc.	All. chan. sel. db	Freq. resp. \pm db	AFC?	AM suppression, db		FM Stereo		Tuning indicator	Stereo indicator	Auto switching?	Dimensions			Price	NOTES	
		1-kc sep.	10-kc sep.	THD%	eye							yes	Width, in.	Depth, in.	Height, in.				Weight, lbs.					
ALTEC LANSING	314A	1.8	1.2						20-20k 1	yes		30			eye		yes	15	10	5½	12¼	359.00		
BOGEN	FT60	2.5	0.7	0.5	3	10	50		20-20k 1	yes	55	38	20	0.7	Meter	Lamp	yes	15	10	4%	11½		s/s	
	TP35	3.0	1.0	0.5	3.5	15	40		30-15k	yes	50	38	20	0.7	eye	Neon	no	15	11%	4%	18			
DYNACO	FM-1	4.0	2.5	0.5	5	30	54		10-40k	no	63				eye			13	4	8	12	79.95k 119.95w	mono FM only	
	FM-3	4.0 non. 6.0 ster.	2.5	0.5	5	30	54		10-15k	no	63	30	14	1	eye	eye	yes	13½	4%	8	13		109.95k 169.95w	
EICO	ST97	3.0							25-15k 1	yes		30			Neon	Neon	no	15%	11%	5%	17		89.95k 129.95w	
ELECTRO-VOICE	EV1155	3.0		1.5	2.5	20	60		10-15k 2	yes	40	30	20	2.0	Meter	Lamp	yes	8¼	10	3%	6		160.00	s/s
	EV1156	3.0		1.5	2.5	20	60		10-15k 2	yes	40	30	20	2.0	Meter	Lamp	yes	8¼	10	3%	6		180.00	s/s, AM also
ERIC	ST100														Meter	Lamp	yes	10½	7	2%			109.00	s/s, guaranteed for life
FISHER RADIO CORPORATION	FM-90-B	2.0	Below noise level	0.5	2.5	10	55		20-15k 1.5	no	60	35	25	0.7	Meter	Neon	no	15%	11%	4%	12		169.50	Golden synchrode front end; front-panel tape jack
	FM-100-C	1.8	Below noise level	0.5	2.2	10	60		20-15k 1.5	no	60	40	30	0.5	Meter	Lamp	yes	15%	11%	4%	13		229.50	Nuvisor golden synchrode front end; front-panel tape jack
	FM-200-C	1.8	Below noise level	0.4	2.0	10	65		20-15k 1.5	yes	60	40	30	0.5	Meter	Lamp	yes	15%	11%	4%	13		279.50	Similar to FM-100-C and adjustable AFC
	TFM-200	1.8	Below noise level	0.5	2.2	10	55		20-15k 1.5	no	60	40	30	0.5	Meter	Lamp	yes	15%	11%	4%	9		229.50	Nuvisor Golden synchrode front end; rest is solid-state; front-panel tape jack
	TFM-300	1.8	Below noise level	0.4	2.0	10	55		20-15k 1.5	no	60	40	30	0.5	Meter	Lamp	yes	15%	11%	4%	9		279.50	Nuvisor Golden synchrode front end; rest is solid-state; front-panel tape jack
GELOSO	6538	2.5	1.0	0.5	2.0	20	62		10-16k 2	yes	50	32	25	1.0	2 Meters	Lamp	yes	17	9	7	12			s/s; has AM. wood cabinet
GROMMES	C107	2.0		0.5	4	10	40		20-20k 0.5	no	55	35	25	0.5	Meter	Lamp	yes	14½	11	4%	10		179.95	s/s; has AM. silent-tuning FM
	2000	2.0		0.5	4	10	50		20-20k 0.5	no	60	35	25	0.5	Meter	Lamp	yes	15	13	6½	12		289.95	s/s; has AM. silent-tuning FM



MARANTZ 10-B TUNER: "... rather spectacular results."

Q. Mr. Marantz, your new 10B stereo FM tuner has caused quite a stir in the hi-fi industry. Now that a large number are in the field, what reactions have you received?

Mr. Marantz: The overwhelming reaction has been one of surprise from owners who found our claims were not exaggerated. One user wrote he had "... taken with a grain of salt your statement that reception was as good as playback of the original tape or disc. However, after using the tuner for several days I felt I owed an apology for doubting the statement." This is typical.

Q. What success have users had with fringe area reception?

Mr. Marantz: Letters from owners disclose some rather spectacular results. From the California coast, which is normally a very difficult area, we have had many letters reporting clean reception from stations *never reached before*. An owner in Urbana, Illinois told us he receives Chicago stations 150 air miles away with a simple "rabbit ears" TV antenna. Another in Arlington, Virginia consistently receives fine signals from Lancaster, Pennsylvania, 125 miles away; Philadelphia, 200 miles away, and three stations in Richmond 100 miles over mountains, which he said "come in as good as local stations."

Q. For the benefit of these readers interested in the technical aspects, what



are the reasons for this improved fringe area performance?

Mr. Marantz: Technical people will find it self-evident that the rare four-way combination of high sensitivity—better than $2 \mu\text{V}$, IHF—both phase linearity and ultra-sharp selectivity in our new advanced IF circuit, and a unique ability to reach full quieting with very weak signals—50 db @ $3 \mu\text{V}$, 70 db @ $24 \mu\text{V}$ —virtually spells out the 10B's superior reception capabilities. Engineers will also appreciate the additional fact that our circuitry exhibits very high rejection of "ENSI," or equivalent-noise-sideband-interference.

Q. Considering the 10B's excellent fringe area performance, shouldn't one pick up more stations across the dial?

Mr. Marantz: Yes. The report published in the April edition of *Audio Magazine* claimed to have logged 53 stations with an ordinary folded dipole used in the reviewer's apartment, which was "more than ever before on any tuner!"

Q. I appreciate, Mr. Marantz, that the 10B's built-in oscilloscope tuning and multipath indicator is very valuable in achieving perfect reception. How big a factor is this device in the total cost of the 10B?

Mr. Marantz: Well, first we should note the fact that no manufacturer would offer a quality tuner without tuning and signal strength meters. Therefore, what we should really consider is the difference in price between ordinary tuning meters, and our infinitely more useful and versatile Tuning/Multipath Indicator, which is only about \$30! While our scope tube and a pair of moderately priced d'Arsonval meters costs about the same—slightly under \$25—the \$30 price differential covers the slight additional power supply complexity, plus two more dual triode tubes with scope

adjustments and a switch. The rest of the necessary associated circuitry would be basically similar for both types of indicator. The price of the 10B tuner is easily justified by its sophisticated precision circuitry and extremely high-quality parts.

Q. With the 10B's exceptionally high performance, does it have any commercial or professional application?

Mr. Marantz: Yes, very much so. In fact, a growing number of FM stations are already using 10B's for monitoring their own broadcast quality. One station wrote that they discovered their 10B outperformed their expensive broadcast monitoring equipment, and were now using it for their multiplexing setup adjustments and tests.

Q. Just how good is the general quality of FM stereo broadcast signals?

Mr. Marantz: As I have remarked on previous occasions, the quality of FM broadcasting is far better than most people realize. The Model 10B tuner has proven this. What appeared to be poor broadcast quality was, in most instances, the inability of ordinary FM receiving circuits to do the job properly. The Model 10B, of course, is based on a number of entirely new circuit concepts designed to overcome these faults.

Q. In other words, the man who uses a MARANTZ 10B FM tuner can now have true high fidelity reception?

Mr. Marantz: Yes, very definitely—even under many conditions where reception may not have been possible before. This, of course, opens up a tremendous source of material for the man who wants to tape off the air, and who needs really good fidelity. He can, as many of the 10B owners are now doing, build a superb library of master-quality tapes, especially from live broadcasts.

New price: \$600—no excise tax.

marantz

MARANTZ, INC. SUBSIDIARY OF SUPERSCOPE INC.
25-14 BROADWAY, LONG ISLAND CITY, NEW YORK

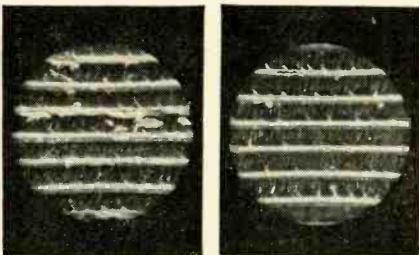
Some plain talk from Kodak about tape:

Slitting accuracy and skew angle

Tape is made in wide rolls which are slit to width— $\frac{1}{4}$ " for most audio tapes. There are three main considerations in this process: cleanliness, dimensional accuracy and trueness of cut. Cleanliness cannot be given too much consideration. When the tape is slit, particles of the oxide and the base can flake off. This condition arises from poor oxide adhesion and poor quality-control standards on slitters. Slitting dirt is virtually nonexistent in Kodak tapes because of our "R-type" binder and our unique slitting techniques.

Tape dirt clogs the recording gap and prevents the tape from making intimate contact with the head, thus causing dropouts and high-frequency losses. Oxide dirt can also cause a phenomenon known as re-deposit. During a normal tape transport operation, gummy oxide dirt can actually re-deposit on the magnetic layer and fuse in position. Just imagine Main Street strewn with giant boulders. Well, that's the way re-deposits appear to your recorder heads. Pleasant thought, isn't it?

To get some idea about how Kodak tape slitting compares to ordinary slitting, take a look at these two photomicrographs. The dirt you see between the turns on the left is oxide dirt. Compare it to the virtually spotless edges of KODAK Sound Recording Tape on the right.

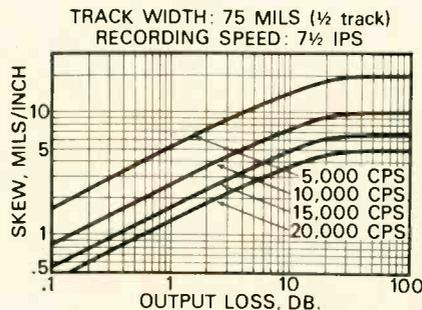


It's like splitting hairs, only more critical

From our 42-inch-wide master web, we have to cut 160 quarter-inch ribbons of

tape — each almost two miles long. That's a lot of total mileage, especially when you think how straight and true those edges must be to assure optimum tracking on your recorder. In terms of slitting accuracy, the standard specs call for a tolerance on width of $\pm .0020$ inches. We decided that that was just about double what it really should be, so we hold ours to $\pm .0010$ inches.

But the really critical part of slitting is a bad guy known as weave. When a tape weaves, it passes the head at a continuously changing skew angle. Look at the graph.

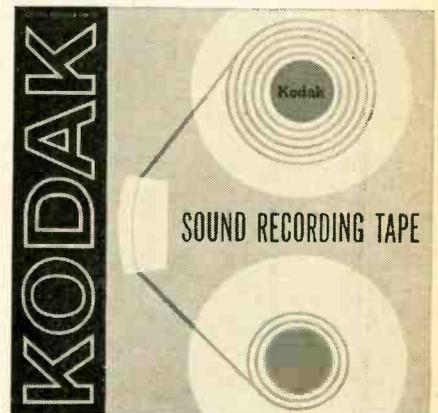


Note how losses pile up as skew angle increases. And as you would guess, the losses are in proportion to the frequency. Higher frequencies, higher losses. Same principle, really, as an azimuth loss.

The patterns of tension set up within the roll when the tape is wound are quite interesting. Normally, the tension at the outside of the roll will decrease until it reaches a point of zero tension about $\frac{1}{3}$ of the way from the core. Beyond this point the tension increases, but the direction of that force is reversed. Near the core the tape is in a state of compression. It's just the opposite with the outer layers. They're clockspringed.

Proper tape tension is also important if you want to prevent "stepping." Stepping usually takes place at the point of zero tension. You can visualize

it as a lateral shearing of a roadway during an earthquake. Shades of old San Francisco. This sets up stresses which cause fluted edges and prevent proper head contact. From winding billions of feet of motion picture film, Kodak has developed some pretty specialized tension-control techniques. The end result, of course, is that when you get Kodak tape on a roll, you know it's wound properly: not too loose, not too tight. Just right. Our Thread-Easy Reel is part of the story, too. Because it is dynamically balanced, we get a good wind right off the bat, and you get a good rewind, too, when you run it on your tape deck.



KODAK Sound Recording Tape in a complete variety of lengths and types is available at most tape outlets: electronic supply stores, specialty shops, department stores, camera stores . . . everywhere.

FREE! New comprehensive booklet covers the entire field of tape technology. Entitled "Some Plain Talk from Kodak about Sound Recording Tape," it's yours on request when you write Department 8, Eastman Kodak Company, Rochester, N.Y. 14650.

©Eastman Kodak Company, MCMLXI

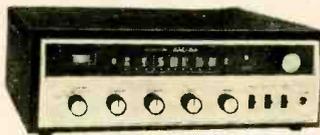
EASTMAN KODAK COMPANY, Rochester, N. Y.

Circle 125 on Reader Service Card

PRODUCT PREVIEW SECTION - TUNERS-3

MANUFACTURER	MODEL NO.	IHF usable sens., μ v.		Volume sens., μ v.	THD%, 100% mod.	Capture ratio, db	Drift, kc.	All. chan. sel. db	Freq. resp. \pm db	AFC?	AM suppression, db	1-kc sep. db	10-kc sep. db	FM Stereo		Tuning indicator	Stereo indicator	Auto switching?	Dimensions				Price	NOTES
		10-kc sep. db	THD%											Width, in.	Depth, in.				Height, in.	Weight, lbs.				
QUAD	QUAD-FM	2		0.5		20 40		50-15k 1	yes	42					Twin Neon	Mono	no	10 1/2	6	3 1/2	6	94.00	Mono FM Multiplex Decoder Avail.	
	QUAD-AM II							50-12k 1							Eye			10 1/2	6	3 1/2	6	104.00		
RADFORD	FMT-1M	4.0		0.5	4	20		10-19k 1	no	60	40	18	0.75	Lamp	Neon	yes	10 1/2	12 3/8	3 3/4	12	250.00			
H.H. SCOTT	312-B	1.9	0.8	0.8	4	20	45	30-15k	no	55	40	30	1.0	Meter	Lamp	yes	15 1/2	13 3/4	9 1/2	13	259.95	s/s		
	350-D	2.2	0.8	0.8	6	20	35	30-15k	no	55	35	30	1.0	Eye	Neon	yes	15 1/2	13 3/4	9 1/2	14	224.95	Multipath Indicator		
SHERWOOD	S-2100 II	1.8	1.8	0.33	2.4	10		20-20k 0.5	no		40	40	0.33	Meter	Neon	no	14	10	4	19	209.50	AM also		
	S-3000 V	1.8	1.8	0.33	2.4	10		20-20k 0.5	no		40	40	0.33	Meter	Neon	no	14	10	4	15	165.00	MX provision		
	S-3000 III	1.8	1.8	0.33	2.4	10		20-20k 0.5	no					Meter			14	10	4	15	120.50	Mono FM MX provision		
	S-2000 IV	1.8	1.8	0.33	2.4	10		20-20k 0.5	no					Meter			14	10	4	15	170.50	Mono FM, AM also		

PRODUCT PREVIEW SECTION - RECEIVERS-1



BOGEN RT4000

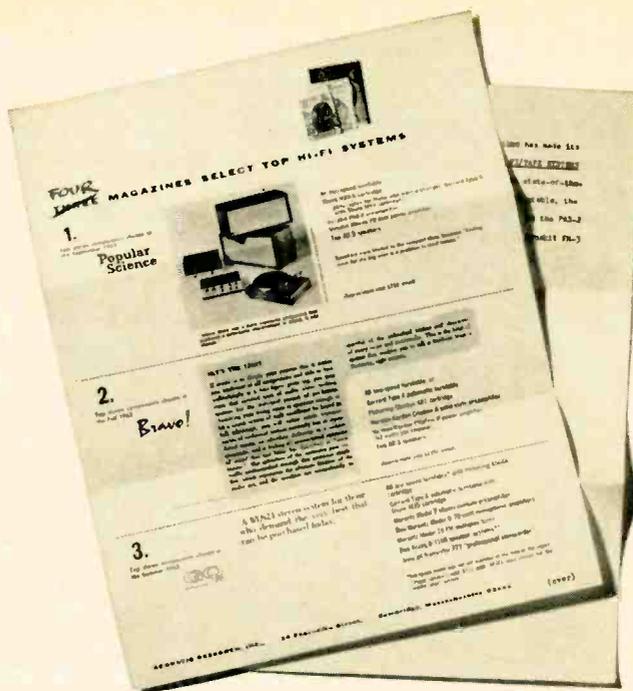


EICO 3566



ELECTRO-VOICE 1177

MANUFACTURER	MODEL NO.	IHF usable sens., μ v.		Volume sens., μ v.	THD%, 100% mod.	Capture ratio, db	Drift, kc.	All. chan. sel. db	Freq. resp. \pm db	AM suppression, db	Stereo sep. db	Stereo sep. db	THD%	Tuning indicator	Stereo ind. type	Auto switching	Dimensions				Price	NOTES
		10-kc sep. db	THD%														Width, in.	Depth, in.	Height, in.	Weight, lbs.		
ALTEC LANSING	711A	50	35	0.5		20-20k 1		10-100k 1	77	5.0 25	2.6	0.5	4-16	50	yes 3-20	16%	12 1/2%	5%	19			all silicon s/s
		2.2	0.9		2.5		20-20k 1	40	40					meter	lamp	yes						
BOGEN	RT 4000	15	20	1.0 0.6	0.8 0.5	20-15k 1		15-40k 3	75	.3 50	3	0.2	4,8,16	35	yes	16	14	4%	19			s/s
		2.5	0.7	0.15	3	10 50	20-20k 1	55	38	24	0.6	meter	lamp	yes								
	RT 8000	30	25	0.6 0.3	0.5 0.3	20-20k 1		10-50k 1	80	2.5 60	2	0.2	4,8,16	40	yes	16	14	4%	19			AM included s/s
		2.5	0.7	0.5	3	10 50	20-20k 1	55	38	24	0.6	meter	lamp	yes								
	RF 35	17.5	15	0.7 0.5	0.6 0.3	30-18k 1		20-30k 1	70	3.5 35	3.5	.25	8,16	20	no	16	15	5%	30			
		3	1	0.5	3.5	15 40	30-15k 1	50	38	20	0.7	eye	neon	no								
RP 235	17.5	15	0.7 0.5	0.6 0.3	30-18k 1		20-30k 1	70	3.5 35	3.5	.25	8,16	20	yes 8/16	16	15	5%	30			AM included	
	3	1	0.5	3.5	15 40	30-15k 1	50	70	20	0.7	eye	neon	no									
EICO	3566	37.5	52	0.5 25	2.0	8-60k 1		5-60k 1	70	3.0		0.18		yes	16 1/2	13 3/4	5	27.5	229.95k 349.95w		Cab. extra With cab.	
		2.0	0.5	4.5		20-15k 1		38		0.5	neon	neon	yes								s/s	



This is a survey (available for the asking) of the hi-fi equipment recommendations of four magazines.

These four lists of equipment choices, from stereo cartridge to speakers, were compiled independently by each of four national magazines — *Gentlemen's Quarterly*, a men's clothing magazine for the carriage trade; *Bravo!*, a concert program "wrapper" with a circulation of almost a million; *Popular Science*, the leading high-circulation science magazine; and *Hi-Fi/Tape Systems*, a hi-fi annual.

AR-3 speakers were the top choice of three of the four.

The fourth magazine, *Gentlemen's Quarterly*, chose speakers costing \$770 each for its most expensive stereo system; AR-3's were relegated to the "middle-range" (\$1,273) system.

The AR turntable was the top choice of all four.

The AR turntable is \$78 including arm, oiled walnut base, and transparent dust cover. The AR-3 is \$203 — \$225, depending on finish (other speaker models from \$51). AR's catalog is available on request.

ACOUSTIC RESEARCH, INC., 24 Thorndike Street, Cambridge, Massachusetts 02141

Circle 126 on Reader Service Card

PRODUCT PREVIEW SECTION — RECEIVERS-4



LAFAYETTE
LR-800



SCOTT 348



SHERWOOD S-800IV

MANUFACTURER	MODEL NO.	Performance										Features					Dimensions			NOTES							
		IHF usable sens. db	IHF power, w/clip	Volume sens. db	THD% RMS	THD% 100% mod	Capture ratio, db	IM ³ , full power/1 w	Drift, kc.	Aft. chan. sel. db	Power bandwidth	Freq. resp., 1 w/± db	AM suppression, db	Stereo sep., 1 kc, db	Hum & noise	Stereo sep., 10 kc, db	Phase resp. sens., mv/° load	THD%	Tuning indicator		Output impedances	Stereo ind. type	Auto switching	Headphone jack	Width, in.	Depth, in.	Height, in.
McINTOSH	MAC-1500	42	30	0.5	0.1	0.5	18-33k	1	20-20k	0.5	76	2.8	56	45	90	2.8	400	4,8,16	10	yes	1	16	13	5	45	499.00	20 transistors, 15 tubes
		2.5	0.5	2	25	6L	20-20k	0.5	30	17	0.8	meter	lamp	yes													
NLS	1	50	40	.7	1.2	.3	15-20k	1	5-32k	3	70	2.7	40		2.7	.3	4,8,16	4	yes	8	15	12	8	42		Plug in epoxy boards. Individual for preamp, audio, if MPX and power supply	
		2.5	1.0	1.0	4	25	55	20-20k	1	55	35	25	1	meter	neon	yes											
PILOT RADIO	R-300	20	15	1.0	2.0	0.25	15-70k	2	15-50k	1	70	3.0	80.0		1.7	0.2	4,8,16	10	yes	8	17	12	5		Approx. 300.00		
		3.0	0.5	5	30	30	20-20k	1	40	30	25	0.5	meter	lamp	yes												
	RA-300	20	15	1.0	2.0	0.25	15-70k	2	15-50k	1	70	3.0	80.0		1.7	0.2	4,8,16	10	yes	8	17	12	5		Approx. 330.00	Has AM	
		3.0	0.5	5	30	30	20-20k	1	40	30	25	0.5	meter	lamp	yes												
	R-700	35	25	0.5	1.0	0.2	7-45k	2	15-55k	1	70	2.5	90.0		1.7	0.2	4,8,16	10	yes	8	17	12	5		Approx. 400.00	Center channel speaker output	
		2.8	0.5	3.5	30	40	20-20k	1	45	30	25	0.5	meter	lamp	yes												
	R-1100	55	40	0.35	1.0	0.3	5-55k	2	10-60k	1	70	2.5	90.0		1.7	0.2	4,8,16	10	yes	8	17	14	5		Approx. 450.00	Center channel speaker output	
		1.8	0.5	1.9	30	45	20-20k	1	50	50	25	0.5	meter	lamp	yes												
PIONEER	ER-810	35	30				30-15k	1			3.0	2.0	0.15			3,16		yes	8-16	17	16	5	35				
		2.0			100	20-20k	1							meter	lamp	yes											
	ER-420	20	15				35-30k	1			2.7	1.8	0.2			8,16		yes	8-16	17	17	6	35				
		2.0			100	20-20k	1							meter	neon	no											
H.H. SCOTT	344-B	30	22.5	0.8	2	0.3	25-20k		15-30k		80	3.5	9	3	0.5	4,8,16	20	yes		15	13	5	25	429.95	s/s		
		2.2	.8	0.8	4	20	45	15-30k	55	35	30	Less 1	meter	lamp	yes												
	348	50	37.5	0.8	2	0.25	0.5	20-20k		15-30k		80	3.5	9	2	0.5	4,8,16	20	yes		18	11	6	25	499.95	s/s	
		1.9	0.8	0.8	2	20	45	15-30k	55	35	30	Less 1	meter	lamp	yes												
	340-B	35	30	0.8	2	0.3	0.3	20-20k		20-20k		80	3.9	3	0.4	4,8,16	10	yes		17	16	6	35	399.95			
		2.2	0.8	0.8	6	20	35	15-30k	55	35	30	Less 1	meter	lamp	yes												
SHERWOOD ELECTRONIC	S-8000 IV	40	36	0.5	1.0	0.25	20-20k		10-25k	+.5	70	1.5	200		1.5	.25	4,8,16	15	yes	4-16	16	14	4	40	329.50	Powered center channel	
		1.8	1.8		2.4	+10	65	10-25k	+.5	75	40	35	.5	meter	neon	no											
	S-7700 III	40	36	0.5	1.0	0.25	.15	20-20k		10-25k	+.5	70	1.5	200		1.5	.25	4,8,16	15	yes	4-16	16	14	4	42	374.50	Powered center channel
		1.8	1.8		2.4	+10	65	10-25k	+.5	75	40	35	.5	meter	neon	no											



Carry-Corder '150' shown 80% of actual size

Norelco® Cordless Tape Recorders



Norelco Carry-Corder® '150'

Tiny tape cartridge loads in seconds, records for an hour

Revolutionary tape recorder, features reusable snap-in cartridges, one button control to start, stop, wind-/re-rewind tape. Separate volume controls for record and playback. Weighs only 3 lbs. with 5 flashlight batteries. 1 7/8 ips constant speed capstan drive. Has dynamic microphone with detachable remote switch. Superior sound quality with frequency response of 100 to 7000 cps. Connections for recording and playback directly with radio, phono, TV or another

tape recorder. 7 3/4" x 4 1/2" x 2 1/4". **Prepacked in Deluxe Case** with 4 cartridges (each in a dust proof container with index card), microphone, fitted carrying case, mike pouch, patchcord and tape mailer. **CIRCLE 51 ON READER-SERVICE CARD**



Norelco Continental '101'

100% transistorized for on the spot record/playback... up to 2 hours on a single reel. 2 track 1 7/8 ips constant speed machine weighs 8 lbs. with 6 flashlight batteries. Features dynamic microphone, tone control, record/level/battery condition indicator. Includes direct recording patch-cord. Frequency response 80 to 8000 cps. 11" x 3 3/4" x 8".

CIRCLE 52 ON READER-SERVICE CARD

Norelco Continental Tape Recorders

Norelco Continental '401'

The recording studio in a suitcase

Fully self contained 4 track stereo record/playback. 4 speeds, 7½, 3¾, 1½, ¾ ips – up to 32 hours on a 7 inch reel. Has dual preamps, power amplifiers, stereo matched speakers. (2nd speaker in lid). Ganged stereo controls eliminate need for dual knobs and microphones. Special facilities include monitoring, mixing, sound on sound, portable P.A. Frequency response 50 to 18,000 cps; wow and flutter less than 0.14% at 7½ ips. Signal to noise ratio better than -48 db.

Weights 39 lbs. 18¼" x 15" x 10".
CIRCLE 53 ON READER-SERVICE CARD



Norelco Continental '201'

New marvel of tape recording versatility

Multi-purpose 4 track tape recorder has every built-in feature for quality recording and playback; 2 speeds, 7½ or 3¾ ips provide up to 8 hours playing time on a single 7 inch reel. Fully self contained. Has dual preamps for stereo playback with external hi-fi system. Special facilities include parallel operation, mixing, pause control, tone control, portable P.A. Frequency response 60 to 16,000 cps.

Weights 18 lbs. 15¾" x 13¾" x 6¾"
CIRCLE 54 ON READER-SERVICE CARD

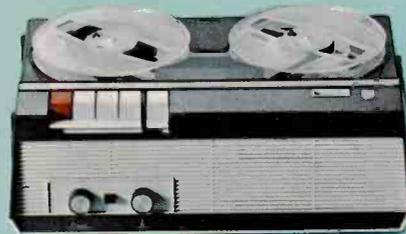


Norelco Continental '95'

Quality engineered, budget priced tape recorder

Compact 3¾ ips speed machine provides up to 3 hours playing time. New automatic record control electronically sets correct recording volume. Make a perfect tape everytime. Has simple pushbuttons to record, playback, wind, rewind, tape pause and stop; adjustable controls for on/off, volume and tone. Frequency response 80 to 12,000 cps.

Weights 12 lbs. 14¼" x 10" x 5".
CIRCLE 55 ON READER-SERVICE CARD



All specifications subject to change without notification.

Norelco Tape Recorder Accessories

FOR MODEL	DESCRIPTION	FOR MODEL	DESCRIPTION
'101'	DL 86 Leather Carrying Case	'95', '101', '150'	TP 86 Telephone Pickup Coil
'101'	CC 86 Texon Carrying Case	'150'	TC 2 x 30 Tape Cartridge
'101'	BE 86 AC Adapter	'201'	EL 3775/21 Monitoring Headset
'101'	RS 86 Remote Mike Switch	'201', '401'	EL 3984/15 Foot Control
'150'	BE 50 AC Adapter	'201', '401'	TP 34/49 Telephone Pickup Coil
'101', '150'	FP 86 Foot Pedal	'401'	EL 3775/37 Stereo Headset
'101', '150'	HP 86 EL 3775/85 Listening Headset	'401'	2A1048 Mike Adapter
'101', '150'	CTM 86 Close Talking Mike		

CIRCLE 56 ON READER-SERVICE CARD

NORTH AMERICAN PHILIPS COMPANY, INC.

High Fidelity Products Department
100 East 42nd Street, New York, N. Y. 10017

PRODUCT PREVIEW SECTION - *TURNTABLES and ARMS-1*



BOGEN B62



ADC 40



CASTAGNA



MARANTZ SLT-12

MANUFACTURER	MODEL NO.	TURNTABLES													ARMS							NOTES				
		Speeds REL. ± at 33	Wow, % at 33	Flutter, % at 33	Motor type	Drive	Platter dia., in.	Platter weight, lbs.	Platter material	Arm mounting provision	Width, in.	Depth, in.	Height, in.	Weight, lbs.	Over-all length, in.	Pivot-stylus, in.	Type of cart. mtg.	Vert. bearing	Hor. bearing	Max. tracking error, %	Cart. wt. range, gms.		Anti-resonance, cps.	Stylus-force range, gms.	Price	
ACOUSTIC RESEARCH	XA	33-45	0.10	0.05	18-p	Belt	11	3.3	alum	integral	16%	12%	5%	13	12	9	Screw Shell	Nylon	Sl. Ball .5	3-20	10-15	0.5	8	78.00	Integrated table	
	TA	33	0.10	0.05	18-p	Belt	11	3.3	alum	integral	16%	12%	5%	13	12	9	Screw Shell	Nylon	Sl. Ball .5	3-20	10-15	0.5	8	75.00	Integrated table	
AUDIO DYNAMICS	ADC 40														10%	9	Plug in Shell	Single Ball	Single Ball	4-15	6	0-4		44.50		
	ADC 84/E														10%	9	Plug in Shell	Single Ball	Single Ball	4-15	6	0-4	0-4	89.50	Includes point Four/E cartr.	
BOGEN	B62	78,45,33,16 cont.	0.12	.03	4-p	Rim	12	7 3/4	zinc alloy	integral	15	13	3 1/2	17 1/2	12	9	Shell	Ball	Ball .5	8-14	8	1	5		Speed continuously adjustable 29-86 RPM auto. cueing - integrated table	
	B51-S	78,45,33,16 infinite	.20	.10	4-p	Rim	12	3 1/2	steel	integrated	15	12	3 1/2	11	12	9	Plug in Shell	Ball	Ball 1	8-14	10	1	5			
CASTAGNA																Plate	Jewel	Mag. adj.				0	5	125.00	Overhang adjust	
ERA	"ERA"	33-34	0.05	0.05	24-p syn.	Belt	12	5	alum	pre-mount	16	15	6	15	12	9	Plug Shell	Uni-pivot	Sl. 2	2-30	10	0.5	3.0	90.00		
EMPIRE SCIENTIFIC	980 Tone Arm														12%	9	Plate	2 Ball	2 0.5 Ball	2-25	6	0.8		49.95	Adjustable overhang	
	208 Turntable	33,45,78,0.3	.03	.02	Hyst. Synch.	Belt	12	6	alum	Base Plate cut out							Plate									
	398 Turntable System	33,45,78,0.3	.03	.02	Hyst. Synch.	Belt	12	6	alum	980 mtd.	17	15	8 3/4	26 1/2	12	9	Plate	2 Ball	2 0.5 Ball	2-25	6	0.8		185.00	Integrated Table	
	498 Turntable System	33,45,78,0.3	.03	.02	Hyst. Synch.	Belt	12	6	alum		16	13 3/4	7 1/2	25	12	9	Plate	2 Ball	2 0.5 Ball	2-25	6	0.8		170.00	Integrated Table	
EUPHONICS	TK-15-LS															12	8 3/4	Plug in cart.	Knife Edge	Ball 1.75	5-3.0	12	0.5	1.5	87.50	Has cartridge and power supply
	TK-15-P															12	8 3/4	Plug in cart.	Knife Edge	Ball 1.75	5-3.0	12	.75	3.0	71.50	Has cartridge
	TA-15															11	8 3/4	Plug in cart.	Knife Edge	Ball 1.75	5-3.0	12	.75	3.0	32.50	Arm only
GRADO	LAB															11 1/4	8 1/4	Plate	Point	Sl. + or - .5	1-30	11	5.8		45.00	Wood

PRODUCT PREVIEW SECTION - TURNTABLES and ARMS-2



PERPETUUM-EBNER PE-34



ORTOFON RMG-212



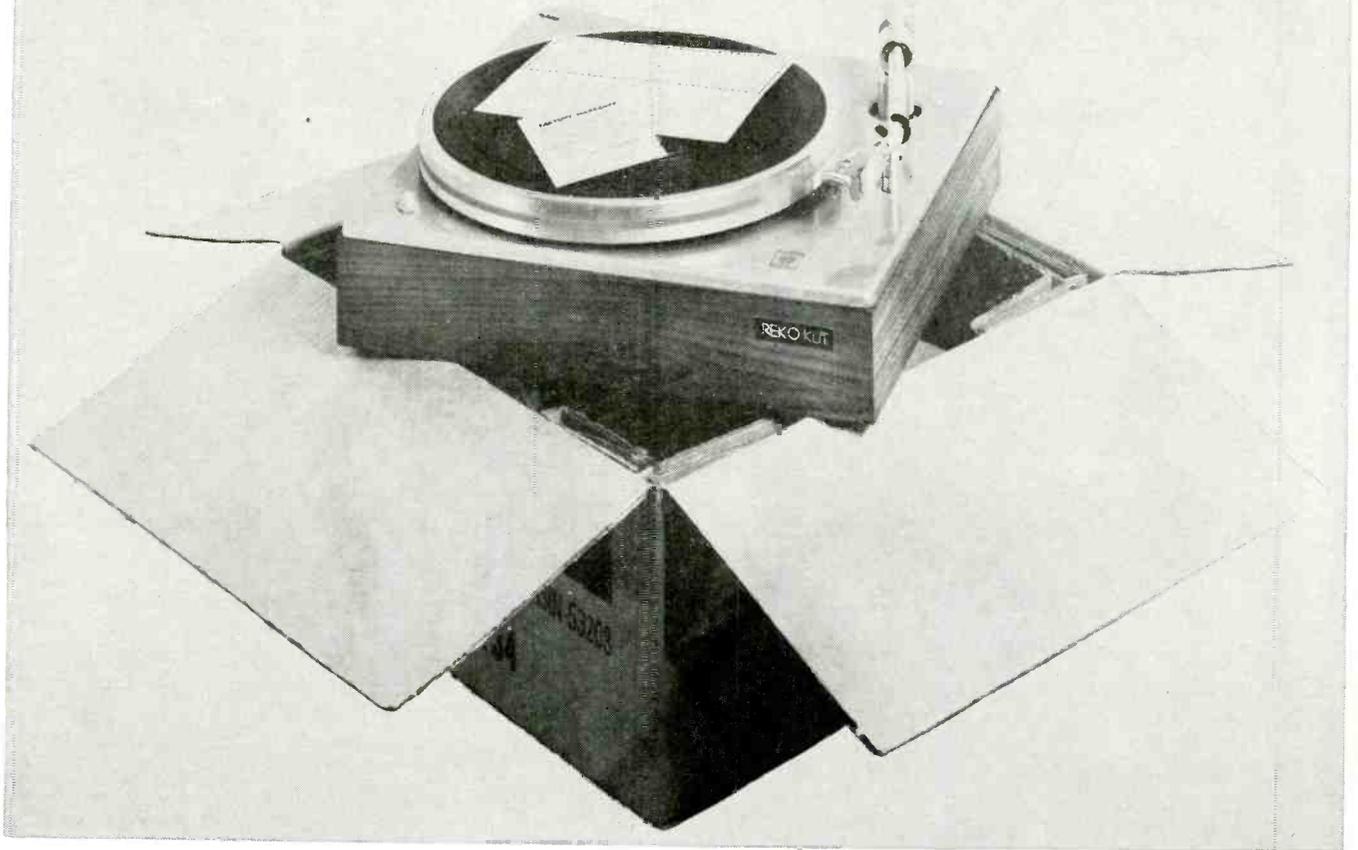
PIONEER



REK-O-KUT R34

MANUFACTURER	MODEL NO.	TURNTABLES														ARMS										NOTES	
		Speeds rpm. 1 at 33 2 at 45		Wow, % at 33	Flutter, % at 33	Motor type	Drive	Platter dia., in.	Platter weight, lbs.	Platter material	Arm mounting provision	Width, in.	Dimensions			Over-all length, in.	Pivot-stylus, in.	Type of cart., mg.	Vert. bearing	Hor. bearing	Max. tracking error, %	Cart. wt. range, gms.	Arm resonance, cps.	Stylus-force range, gms.	Price		
		Depth, in.	Height, in.										Weight, lbs.														
MARANTZ		33-45			Hys/syn.	kiler	10				18	14	6 1/2	27				Gear	1						295.00	Straight-line tracking - has cart.	
ORTOFON A/S	RMG 212													12	9	Plug in Shell	Ball	Ball 1.2	5-17	8	0.7			55.00			
	SMG 212													12	9	Plug in Shell	Ball	Ball 1.2	5-17	8	0.12			30.00			
	SKG 212													12	9	Plug in Shell	Ball	Ball 1.2	5-17	8	2.12			20.00			
	RMG 309													16	12 1/2	Plug in Shell	Ball	Ball 0.8	5-17	7	0.7			60.00			
PERPETUUM-EBNER	PE34	4 + 3	0.2	0.15	4p	belt plus idler	10 1/6	4	zinc		13	3 25/32	2 29/32	11	11	3 3/16	Slide	Knife Edge	Ball 1.5	1-19	10	1.6			72.00	Integrated Table	
PIONEER	PL-7U	33-45 78 3	0.15	0.1	4p	HS	12	3.5	alum	Die cast panel	17	13.6	7.5	10.5	12	9.5	Fric Steel	Ball	Ball 2	5-20	9	0.4				Integrated Table	
REK-O-KUT	R-34	33-45	.08	.08	Hys/syn.	Belt	12	4	alum		15	15	5 1/2	20	12	9	Shell	Ball	Ball 1	3-30	9-12	0.25			89.95	Integrated Table	
	B-12H	33-45 78	.085	.085	Hys/syn.	Idler	12	5	alum	Hole in Deck	18	16	10	19											165.00		
	B-12GH	33-45 78	.09	.09	Hys/syn.	Idler	12	5	alum	Hole in Deck	18	16	8	17											109.95		
	B-16H	33-45 78	.085	.085	Hys/syn.	Idler	16	9	alum	Hole in Deck	20	19	8	34												275.00	
SHURE/SME	3009														9	std	knife edge	ball adj						5	100.50	British-made anti-skating	
	3012														12	"	"	"	"					5	110.50	"	
STANTON	800B										12%	12%	6%					point						0-3			arm only
	2008																										
THORENS	TD124/22	4 ±3	0.15	.05	4p	belt & idler	12	8	alum & zn	wood board	15 1/2	12 1/4	5 1/2													125.00	
	TD150 AB	33-45	0.15	.05	syn	belt	12	7 1/2	zinc alloy	wood board	15 1/2	12 1/4	5	15	12 1/4	9 1/2	plug shl	slv & ball	ball 2.5 @ 12"	5-19	10	0.5-4.5			99.75	adj. vert. trkg. angle	
	TD121	33 ±3	0.15	0.1	4p	belt & idler	12	7 1/4	"	"	15 1/2	12 3/4	4 1/2	16 1/2												85.00	
	TP-12														12	8 1/2	shl	ball	ball 30 @ 10"	5-19	10	0.5-4			49.50	adj. vert. trkg. angle	

WE AREN'T AFRAID TO PUT A FIVE YEAR WARRANTY ON THE REK-O-KUT R-34 TURNTABLE



SO WE DID!

You don't find many 5 year warranties in the audio business. It's a shame, isn't it? Well, we're not afraid of it. The Rek-O-Kut R-34 is made to last . . . and our five year warranty proves it.

The quality to support it is built into the R-34. Hysteresis synchronous by Papst is normally found only in more expensive units. Exclusive Rekothane belt is ground to precision tolerances to reduce noise and rumble minus 6 db lower than any other belt. One-piece cast aluminum table is dynamically balanced with weighted rim for perfect rotation at constant speed. And more, too. \$89.95 with tonearm and base.



also manufacturers of famous Koss Stereophones

KOSS **REK-O-KUT**

2227 NORTH 31ST STREET
MILWAUKEE, WISCONSIN 53208

Circle 128 on Reader Service Card

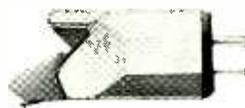
PRODUCT PREVIEW SECTION — PHONO CARTRIDGES-1



ADC POINT FOUR



DYNACO SD-II



EMPIRE 888 P

ABBREVIATIONS: MM= moving magnet; MI= moving iron; MC= moving coil; cer= ceramic
 Stylus: E= elliptical; R= round; D= diamond; S= sapphire. Replacement: F= factory; U= user; I= interchangeable.

MANUFACTURER	MODEL NO.	Type	Mono db Stereo / s		IM dist, %	I-kc separation, db			Output, mv, 3-.54 cm/sec	Recommended load, ohms	Tracking force, gms	Eff. stylus mass, mg	Lat. compl. x 10 ⁻⁶	Vert. compl. x 10 ⁻⁶	Stylus type	Stylus radius, mils	Replacement	Max. shunt C, pf	Mounting dimensions	Weight, gms	Price	NOTES
			1	2		1	2	1														
AUDIO DYNAMICS CORPORATION	ADC POINT FOUR/E	S	10-20k	2	1	30	20	4	47	3/4 -1 1/2	30	30		.2/7	U	400	std	6.5	60.00		Induced magnet	
	ADC 660/E	S	10-20k	3	1	30	20	4	47	1-3	20	20	ED	.2/7	U	400	std	6.5	39.50		Induced magnet	
	ADC 770	S	10-20k	3	1			7	47	2-6	15	15	RD	.7	U	400	std	6.5	29.50		Induced magnet	
	ADC 809/E	S	10-20k	3	1	30	20	4	47	1-3	20	20	ED	.2/7	U	400	std	7.5			Induced magnet	
DECCA (ENG.)	MK. IV	MI S	10-22k	1	2.0	30	18	3.8	47k	1.5	.85	26	10	ED	.3/6	F	300	std	12	70.00		
	MK. III	MI S	10-16k	1 db	2	30	18	4.0	47k	2.0	1.0	15	4	ED	.3/8	F	300	special	14	70.00		Fits IMF or SME arms only
	MK. II	MI S	15-16k	1 db	2	20	15	5.0	47k	3.5	1.2	10	2	RD	0.56	F	300	special	14	60.00		Fits IMF or SME arms only
	78 RPM	MI M	20-12k	1 db	3			6.0	47k	3.5	1.4	3	2	RD	.2/8	F	300	special	14	40.00		Fits IMF or SME arms only
DYNACO	SD-II	MI	30-15k	2		22	22		47k	1.4	3	5	5	RD	.7 .5 3.0	U		std	10	17.95		
	SD-III	MI	20-20k	2.5		20	20		47k	1.3	1.5	14	14	RD	.7	U		std	10	19.95		
ELAC	222	MM S	20-20k	2 db	2	24		10	33-51 k	2.0		7	5	RD	0.70	U		std	9	39.50		
EMPIRE	888P	M	10-28k	1.0	30	20	8.0	47k	1 1/2	.5	15	15	RD	.6	U	350	std	7	21.95			
	888PE	M	8-30k	0.8	30	20	8.0	47k	1	.5	20	20	ED	.2/9	U	350	std	7	32.95			
	880	M	12-24k	1.4	30	20	8.0	47k	2	.7	10	10	RD	.7	U	350	std	10	17.95		15 degree vertical tracking angle	
	880P	M	10-28k	1.4	30	20	8.0	47k	1 1/2	.7	15	15	RD	.6	U	350	std	10	19.95			
	880PE	M	8-30k	1.2	30	20	8.0	47k	1	.7	20	20	ED	.2/9	U	350	std	10	29.95			
EUPHONICS	CK-15-LS	S	20-20k	2	1.0	25	15	8.0 mag. .4 cer.	47k	.75	.6	25	25	ED	.2/9	U		std	2.0	55.00		Lab. std. kit, including U-15-LS cart. and power source - silicon semiconductor
	CK-15-P	S	20-20k	2	1.0	25	15	Same	47k	1.3	.7	15	15	RD	.5	U		std	2.0	30.00		Silicon semiconductor-Professional series kit, including U-15-P cart. and power source
GRADO		MC S	10-50k		0.5	30	25	3.2	47k	1.2	0.3	35	30	ED	.3/9	F		std	6 1/2	49.50		Twin-tip stylus

**This was the E-V Model 635.
It started a tradition
of excellence in
dynamic microphones.**



**This is the new
E-V Model 635A.
It's better
in every way!**



Model 635A Dynamic Microphone \$82.00 List. (Normal trade discounts apply.)

E-V How can a microphone as good as the E-V Model 635 be made obsolete? By making it better! It wasn't easy. After all, professional sound engineers have depended on the 635 since 1947.

During this time, the 635 earned a reputation for toughness and dependability that was unrivalled by other omnidirectional dynamics. And internal changes through the years have kept the 635 well in the forefront of microphone design.

But now the time has come for an all new 635: the Electro-Voice Model 635A. It's slimmer, for easier hand-held use. Lighter, too. With a slip-in mount (or accessory snap-on Model 311 mount) for maximum versatility on desk or floor stands. The new, stronger steel case re-

duces hum pickup, and offers a matte, satin chromium finish perfect for films or TV.

The new 635A is totally new inside, too—and all for the best. A new four-stage filter keeps "pops" and wind noise out of the sound track, while guarding against dirt and moisture in the microphone, completely eliminating any need for external wind protection. Of course you still get high output (—55db) and smooth, crisp response. And you can still depend on the exclusive E-V Acoustalloy[®] diaphragm that is guaranteed against failure for life* (it's that tough)!

We expect to see plenty of the "old" 635's in daily use for years. But more and more, the new 635A will take over as the new standard. It's easy to find out

why: just ask your E-V Professional Microphone distributor for a free demonstration in your studio. Or write us today for complete data. We'll be proud to tell you how much better the new Model 635A really is!

*The E-V Professional Microphone Guarantee: All E-V professional microphones are guaranteed UNCONDITIONALLY against malfunction for two years from date of purchase. Within this period, Electro-Voice will repair or replace, at no charge, any microphone exhibiting any malfunction, regardless of cause, including accidental abuse. In addition, all E-V microphones are GUARANTEED FOR LIFE against defects in the original workmanship and materials.

ELECTRO-VOICE, INC. Dept. 851A
602 Cecil Street, Buchanan, Michigan 49107

Electro-Voice[®]
SETTING NEW STANDARDS IN SOUND

PRODUCT PREVIEW SECTION — PHONO CARTRIDGES-2



PICKERING V15

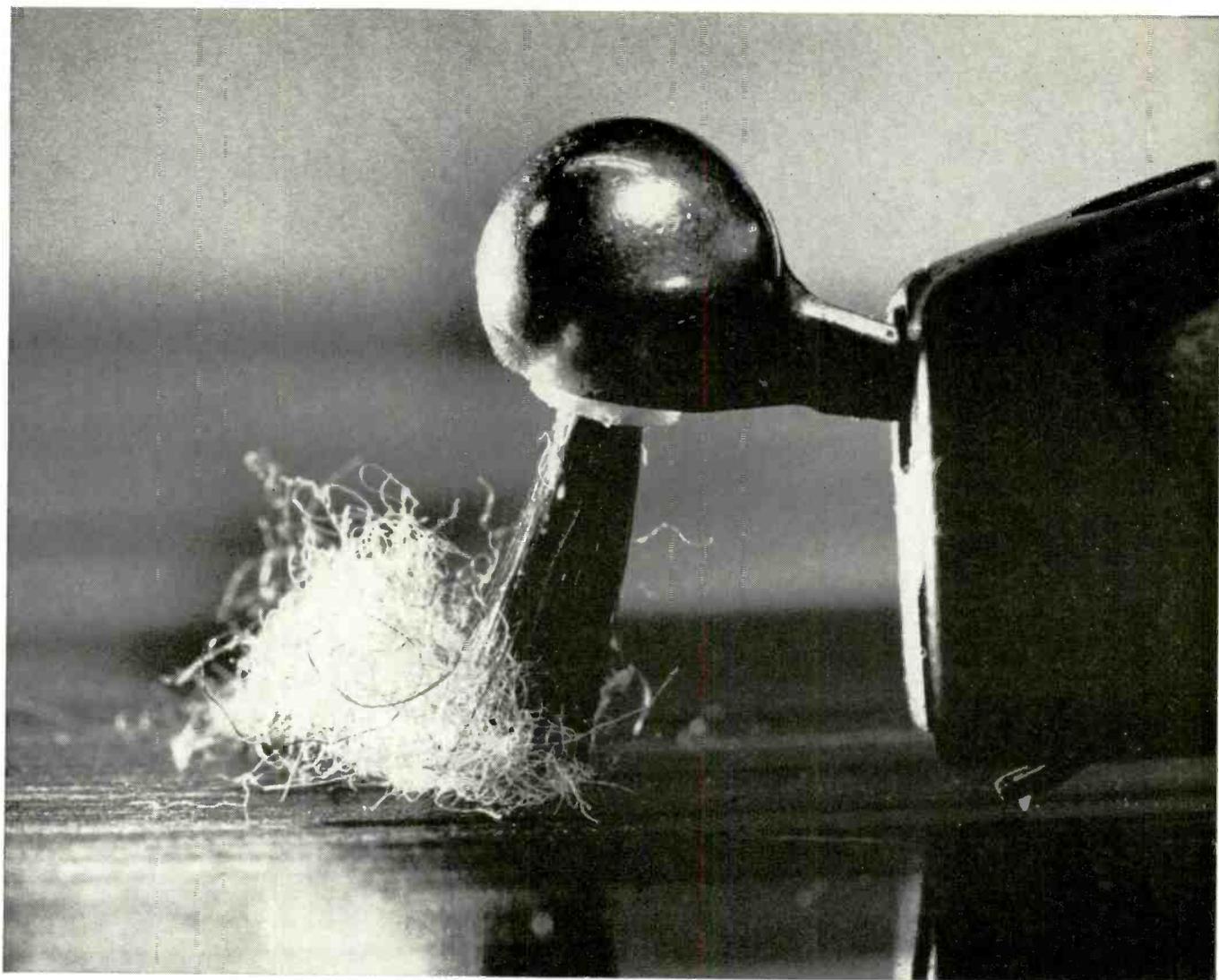


SHURE M80E



SONOTONE 25TLR

MANUFACTURER	MODEL NO.		Type Mono, m, Stereo, s	Freq. resp. ± db	IM dist. %	I-xc separation, db			O-xc separation, db			Output, mv, 3-5k cm/sec	Recommended load, ohms	Tracking force, ohms	Eff. stylus mass, mg	Lat. compl. x 10 ⁻⁶	Vert. compl. x 10 ⁻⁶	Stylus type	Stylus radius, mils	Replacement	Max. tilt, C, pf	Mounting dimensions	Weight, gms	Price	NOTES
	MM	S				20-20k	2	35	25	18.0	47k														
PICKERING	380C	MM S	20-20k	2	35	25	18.0	47k	4.7									RD	.7	UI	250	std	14	11.76	
	V15AMEI	MM S	20-20k	2	35	25	5.5	47k	3/4-1 1/2									ED	25/.85	UI	275	std	5	29.95	
	V15AM-1	MM S	20-20k	2	35	25	5.5	47k	3/4-3									RD	.7	UI	275	std	5	21.95	
	V15AT-2	MM S	20-20k	2	35	25	7.5	47k	2.5									RD	.7	UI	275	std	5	19.95	
	V15-AC2	MM S	20-20k	2	35	25	7.5	47k	3.7									RD	.7	UI	275	std	5	17.95	
SHURE	V-15	MM S	20-20k		25	20	5.05	47k	3/4-1 1/2				25	25	ED	.2/.7	U				std	11	62.50	15 degree tracking	
	M-55E	MM S	20-20k		25	20	5.05	47k	3/4-1 1/2	1.1		25	25	ED	.2/.7	U				std	7	35.50	15 degree tracking		
	M-80E	MM S	20-20k		25	20	5.05	47k	1 1/4			25	25	ED	.2/.7	U			shell	23.5	38.00	Mounted in shell for use in Garrard Lab 80 on model M70. Spring suspension for bounce proof performance			
	M-44C	MM S	20-20k		25		6.6	47k	3-5			7	7	R	.7	U				std	7	17.95	15 degree tracking		
	M7/N21D	MM S	20-20k		20		3.45	47k	2 1/2 max.			9	9	R	.7	U				std	7.9	17.95			
SONOTONE	Velocitone Mark IV	S	20-20k 3	3	27	5	9	47k	2	3	15	15	RSD	.7/3	U		850	std	3.0	23.15		3.0	23.15	Turnover type	
	9TAF-HC-SD	S	50-16k 3	3	27	5	200	1 meg 100 pf	2	3	15	15	RSD	.7/3	U		850	std	3.0	15.15		3.0	15.15	Turnover type	
	16TAF-SD	S	80-12k 3	3	25	5	630	2 meg 100 pf	6	5	2.5	2.5	RSD	.7/3	U		600	std	2.5	11.65		2.5	11.65	Turnover type	
	24T-SD	S	20-10k 3	3	25	5	260	0.5 meg 100 pf	6	6	3.5	3.5	RSD	.7/3	U		5000	std	3.0	13.95		3.0	13.95	Turnover type	
	25TMB-SD	S	50-20k 3	3	25	10	200	2 meg 100 pf	2	3	15	15	RSD	.7/3	U		1200	std	3.0	14.70		3.0	14.70	Turnover type	
STANTON	581-EL	MM S	20-20k 2		35		3.5	47k	0.5-1.5									ED		U	250	std	5	49.50	1 and 2.7 mil stylus avail.
	581-AA	MM S	20-20k 2		35		3.5	47k	0.5-1.5									RD	0.5	U	250	std	5	49.50	1 and 2.7 mil stylus avail.



You are looking at the world's only true **longhair** cartridge.

In this unretouched photograph, the long, black hair of the brush built into the new Stanton 581 is shown in action on a rather dusty record. Note that all the loose lint, fuzz and dust are kept out of the groove and away from the stylus. That's why the Longhair is the ideal stereo cartridge for your Gesualdo madrigals and Frescobaldi toccatas. Its protective action is completely automatic, every time you play the record, without extra gadgets or accessories.

The stem of the brush is ingeniously hinged on an off-center pivot, so that, regardless of the stylus force, the bristles never exert a pressure greater than 1 gram and always stay the right number of grooves ahead of the stylus point. The bristles provide just the right amount

of resistance to skating, too.

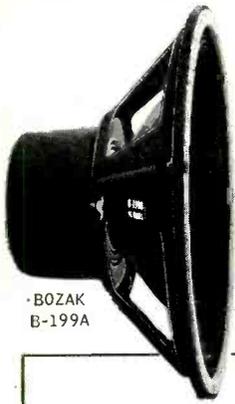
But even without the brush, the Stanton 581 Longhair is today's most desirable stereo cartridge. Like its predecessors in the Stanton Calibration Standard series, it is built to the uniquely stringent tolerances of Stanton professional audio products. Its amazingly small size and light weight (only 5 grams!) make it possible to take full advantage of the new low-mass tone arms. And its frequency response is factory calibrated within 1 db from 20 to 10,000 cps and within 2 db from 10,000 to 20,000 cps. Available with 0.5-mil diamond (581AA) or elliptical diamond (581EL); price \$49.50.

For free literature, write to Stanton Magnetics, Inc., Plainview, L.I., N.Y.

Stanton

Circle 130 on Reader Service Card

LOUDSPEAKER MECHANISMS-1



BOZAK
B-199A



ALTEC 604E



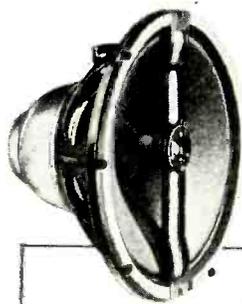
ELECTRO-VOICE SP12B

EMPIRE 9000/15



MANUFACTURER	MODEL NO.	Type	Diameter, in.	Freq. resp. ± db	Resonance, cps.	Cone material	Suspension compliance	Type of suspension	Magnet Type	Magnet weight, lbs.	Voice-coil material	Voice coil dia., in.	Power capacity, watts	Depth, in.	Weight, lbs.	Efficiency, EIA	Price	NOTES	
ALTEC	604E	full range coax	15	20-22k	25	cloth			Al. V	LF 4.4	copper rib	Lf 3 HF 13	35	34	53		199.00		
	755C	thin full range	8 3/8	40-15k	52	paper			indox V	3		2 1/2	15	2 1/2	3.75		32.25		
	415C	full range	15	25-14k	27	paper			Al. V	2.4	Al. rib	3	25	7	17 1/2	54		67.50	
	416A	woofer	15	20-16k	25	fibre		cloth with mechanical resistance	Al. V	2.4	copper rib	3	30	7	17 1/2	52		63.00	
	601C	full range	12	30-22k	39				Al. V	LF 1.8 HF 185	Al. rib	Lf 3 HF 30 peak	20	5 3/8	15	52		119.00	
BOZAK	B-199A	woofer	12	30-5k 4	35	paper	medium	cloth	Al. V	1 1/2	cu. wire	1 1/2	40	5 7/8	9		54.50	Des. for infinite baffle	
	B-209B	mid range	6	200-5k 3	80	metal	medium	rubber	Al. V	1 1/2	cu. wire	1	25	3 1/2	7		52.50		
	B-800	full range	8	60-15k 5	65	metal	medium	cloth	Al. V	1 1/2	cu. wire	1	25	3 3/4	7		47.50	All purpose weatherproof	
	B-200Y	tweeter	dual 2	2-16k		metal		metal	Al. V	1	cu. wire		10	2 1/2	2 1/2		33.50		
	B-207A	coax		30-16k 5	35	paper & metal	medium	cloth & metal	Al. V	2 1/2	cu. wire	1 1/2 3/4	40	7	15			For infinite baffle	
ELECTRO-VOICE	SP-12	full range coax	12	30-15k	45	paper	medium	cloth	Al. V	3	Al.	2 1/2	80 peak	7 1/2	19	53		65.00	
	15TRX	full-range 3-way	15	25-20k	25	phen	medium low	cloth	Indox cer Al. V	4 3/8 6.8 oz	Al.	2 1/2	80 peak	8 1/4	27	55		130.00	
	SP8B	full range coax	8	35-15k	60	paper	medium	cloth	Indox cer	1 3/8	Al.	2	40 peak	4 3/4	7	47		31.00	
	T350	Comp. tweeter	7 1/2	3500/23k		phen	low	phen	Al. V	1	Al.	1	100 peak	4 1/2	7	60		66.00	
	30W	woofer	30	15/300	15	plas foam	medium	cloth	Indox cer	9 3/4	Cu. ribbon	2	200 peak	13 1/2	34	54		250.00	100 cps rec. crossover
EMPIRE SCIENTIFIC	8000/12W	woofer	12	25/450	25	paper	high	cloth	Indox cer	6	Cu. wire	4	60	4	21	50		69.95	des. for inf. baf or reflex as low as 1.5 cu ft
	9000/15W	woofer	15	20/450	20	paper	medium	cloth	Indox cer	6	Cu. wire	4	60	4	23	50		84.95	As above for 3 to 8 cu ft
	9000/MXH	mid + tweeter	10 3/8 x 6 1/4	450/20k		phen domes	medium	phen	Al. V	4	Cu. wire		50		12	50		89.95	Dir. rad. mid + dome tweeter + x-over network
GELOSO	TW109	tweeter	4	2k-18k													9.95		
	SP201	wide range	8	50-10k													20.95		
	SP303	full range coax	12	40-18k													49.95		
HARTLEY	218MS	Woofer	18	16-3k 3	17	polymer	med. hi	mag & cloth	Al VII	14	Cu. wire	1 1/2	40	8	16		195.00	alum v.c. form	
	220MS	full range coax	10	16-20k 3	21	polymer	med. hi	mag & cloth	Al V	6.1	Al & cu wire	1	25	5	7 1/2		135.00	Des for infinite baffle	
	312	full range coax	12	25-20k 5	38	paper poly	med. low	cloth phen	Al V	6.1	Cu wire	1	20	6	8		99.95	Best in inf. baffle; Al v.c.	
	310	full range coax	10	30-20k 5	28	paper poly	med. low	cloth phen	Al V	6.1	Cu wire	1	20	5	7 1/2		85.00	Best in inf. baffle	

LOUDSPEAKER MECHANISMS-2



HEATH S-183



JORDAN WATTS DHE6525



KNIGHT 615 HC



LANSING LE175 DLH



MANUFACTURER	MODEL NO.	Type	Diameter, in.	Freq. resp. ± db	Resonance cps.	Cone material	Suspensions compliance	Type of suspension	Magnet type	Magnet weight, lbs.	Voice-coil material	Voice coil dia., in.	Power capacity, watts	Depth, in.	Weight, lbs.	Efficiency, EIA	Price	NOTES
HEATH	AS-183	coax	12	20-15k	25		high		cer	1.75 0.30		1½ 1	30	4	13		49.95	
	AS-173	3-way coax	12	35-15k	40		high		cer	1.75 0.15		1½ 1	25	4	12		39.95	
	AS-163	3-way coax	12	40-15k	60				cer	0.8 .06		1½ 1	20	4	10		29.95	
JENSEN	SG-300	full range 3-way	12	20-20k 5	20	paper plas. plas.	high	imp. cloth	cer		Cu. Alum	1½ 1½ 1	40	8 ¾	16		99.50	
	G-610B	full range 3-way	15	25-20k 5	35	paper plas. plas.	med.	paper	Al V	6½	Cu. Alum	3 2 1	40	10 ½	46		296.50	
	G-600	full range 3-way	15	30-20k 5	50	paper plas. plas.	med.	paper	Al V	3½	Cu. Alum	2 1½ 1	35	10 ½	33		157.50	
	SG-222	full range coax	12	30-15k 5	50	paper plas.	med.	paper	cer	1	Cu. Alum	1½ 1	25	7½	12		69.50	
	SG-220	full range coax	12	20-15k	40	paper plas.	high	imp. cloth	cer	1 1	Cu. Alum	1½ 1	20	5½	11		52.00	
JORDAN-WATTS		modular unit	4	35-20k 3	40	Alum.	high	BeCu struts	Feroba	6	Alum rib'n	1¼	12	4	12		60.00	Stack for hi pwr l.f. resp to 20c
KELLY		Tweeter	4 x 8	2k-22k 1	1000	Alum rib'n	med.	visc-aloid	Feroba	6	Alum	¾ w	20	8	12		75.00	incl. x-over
		Woofer	12	30-5k 2	25	phen paper	high	imp. cloth	Feroba	12	Alum	2	35	8	25		75.00	for lab'tn, reflex, or inf. baffle
KNIGHT	KN-822HC	2-way	12	25-13k	30	paper	high	paper	cer	13 oz.	Cu. wire	1¼	20/40	6¾	7½	45	12.95	
	KN-839	3-way	8	45-18k	65	paper	med.	paper	cer	10 oz.	Cu. wire	2 1	20/40	3¾	6¾	45	19.95	
	KN-809A	2-way	8	50-13k	60	paper	med.	paper	cer	10 oz.	Cu. wire	1	15/30	3¾	3¾	40	8.95	
	KN-615HC	3-way	15	20-20k	25	paper	high	cloth roll	cer	4	Cu. Alum	2½ 1	50/80	8¼	3	53	69.95	
	KN-830HC	3-way	12	25-18k	30	paper	high	paper	cer	13 oz.	Cu. wire	1¼	20/40	6¾	11	47.2	22.50	
LANSING (JBL)	LE14A	Woofer	14		25	paper plas.	high	mold d plas.	Al V		Cu. rib'n	4	30	5¼	21	43	105.00	for small encl. or inf. baffle
	LE175/DLH	Tweeter horn/lens	5¾	500 up		Alum.			Al V		Alum rib'n	1¼	25	11 ¾	12	58	96.00	lens gives 90° unif. dispers'n
	LE10-7	Passive radiator	10	below 150		paper	high	mold d plas.						2½	3		9.00	drone radiator replaces port
OXFORD	HCT-12	full range coax	12	25-17k	30		high		cer	10 oz			15				18.32	
	HCW-12	full range coax	12	25-13k	30		high		cer	10 oz			13				15.64	
	C121408	full range coax	12	45-15k			low		Al V	6.8 oz			20				15.00	
	HCT8	full range coax	8	30-17k			high		cer	10 oz			12				12.45	
	HCW-8	full range coax	8	30-17k			high		cer	10 oz			11				7.50	

PRODUCT PREVIEW SECTION —

LOUDSPEAKER MECHANISMS-3



STENTORIAN HF1214



VITAVOX K15/40

MANUFACTURER	MODEL NO.	Type	Diameter, in.	Freq. resp. Hz db	Resonance, cps.	Cone material	Suspension compliance	Type of suspension	Magnet type	Magnet weight, lbs.	Voice-coil material	Voice coil dia., in.	Power capacity, watts	Depth, in.	Weight, lbs.	Efficiency, EIA	Price	NOTES
R & A	DUAL 1262	full range coax	12	35-18k	45	paper paper	high rigid	chem. treated	Alco-max 3		Cu. wire	1 3/4	30	6	4 1/4		39.93	Incl x-over
	9120DEL	full range coax	12	40-16k	60	paper paper	medium	chem. treated	Alco-max 3		Cu. wire	1	25	5 1/2	3 1/2		13.95	any type encl.
	980DEL	full range coax	8	60-14k	65	paper paper	medium	chem. treated	Alco-max 3		Cu. wire	1	15	4	2 1/4		9.95	any type encl.
	880DEL	full range coax	8	60-14k	70	paper paper	medium	chem. treated	Alco-max 3		Cu. wire	1	10	3 3/4	1 1/2		7.95	any type encl.
	750 Mark IV	mid range + tweeter	5	3k-18k		paper paper	stiff		Alco-max 3		Cu. wire	3/4	10	2 1/2	7/8		9.95	
STENTORIAN	DUPLEX 15	full range coax	15	20-20k 3	35	fabric paper/alum	med. high	cloth	Al V	16 total	Al. wire	2	25	9 1/4	3 1/2	high	159.50	
	HF1214	full range	12	25-14k	35	fab+ paper	high	phen	Al V	5	Cu. wire	1 1/2	15	6	13	high	52.50	
	HF1012U	full range	10	30-14k	35	fab+ paper	high	cloth	Al V	2	Cu. wire	1	10	4 1/2	6 1/2	high	18.95	v.c. 4, 8, and 16 ohms
	HF812U	full range	8	50-12k 3	65	fab+ paper	high	cloth	Al V	2	Cu. wire	1	10	3 3/4	4 1/2	high	14.95	v.c. 4, 8, and 16 ohms
	T359	tweeter	3 1/2	3k-17k		paper	low	paper/phen.	Al V	8 oz.	Cu. wire	3/4	15		1	high	14.95	
TANNOY	Monitor Dual Concentric	full range coax	15	23-20k 3	32	paper dural	med. low	paper dural	Tic G	13	Cu. Alum.	2	50	9	21	high	179.00	for inf. baffle, reflex, or horn
	Monitor Dual Concentric	full range coax	12	25-20k 3	35	paper dural	med. low	paper dural	Tic. G	7	Cu. Alum.	2	30	7 1/2	10	high	138.00	for inf. baffle, or bass reflex
	Monitor Dual Concentric	full range coax	10	27-20k 3	27	paper dural	med. low	paper dural	Tic G	6	Cu. Alum.	2	20	6 1/2	9	high	112.75	for inf. baffle, reflex, or horn
LTV UNIVERSITY	MUSTANG M-8	full range sgl. cone	8	70-10k	65	stiff paper	med.	imp. paper	cer	20 oz.	Cu. wire	2	30	2 1/2	5	54.6	19.00	die-cast frame 5-yr warranty
	MUSTANG M-8D	full range dual cone	8	70-12k	55	stiff paper	med.	imp. paper	cer	20 oz.	Cu. wire	2	30	2 1/2	5	54.6	18.50	die-cast frame 5-yr warranty
	MUSTANG M-12	full range sgl. cone	12	35-10k	45	stiff paper	med.	imp. paper	cer	20 oz.	Cu. wire	2	30	3 3/8	7	55.2	20.50	die-cast frame 5-yr warranty
	MUSTANG M-12T	full range 3-way	12	35-40k	40	stiff paper phen.	med	imp. paper	cer Al V	20 oz. 6oz	Cu. wire Al.	2 .78	30	3 3/8	8 1/2	54.1	32.00	die-cast frame 5-yr warranty
	MUSTANG M S	super tweeter	3 3/4	3k-40k		phen.		phen	Al V	6 oz.	Alum wire	.78	30	3 1/8	1/2	55.2	16.95	5-yr warranty
UTAH*	C8JC-2	full range 2-way	8	35-19k	65	paper paper	med. low	cone paper	BF	10	Cu. wire	1	30	3 1/8	4 3/4	high	12.95	
	C8JC-3	full range 3-way	8	35-20k	50	paper paper paper	high med. low	cloth roll	BF Al 8	10 1.47	Cu. wire	1 3/16	30	3 1/8	5 1/2	high	17.95	
	C12JC-1	full range	12	30-14k	50	paper	med.	cone paper	BF	10	Cu. wire	1	35	5 1/16	9 3/4	high	19.95	
	C12PC-2	full range 2-way	12	25-19k	50	paper paper	med. low	cone paper	BF	20	Cu. wire	1 1/2	45	5 1/16	10 3/4	high	24.00	
	C12PC-3	full range 3-way	12	25-20k	25	paper paper paper	high med. low	cloth roll	BF Al 8	20 1.47	Cu. wire	1 1/2 3/16	45	5 1/16	11 3/4	high	29.95	

PRODUCT PREVIEW SECTION —

LOUDSPEAKER MECHANISMS-4

MANUFACTURER	MODEL NO.	Type	Diameter, in.	Freq. resp. Hz. db	Resonance, cps.	Cone material	Suspension compliance	Type of suspension	Magnet Type	Magnet weight, lbs.	Voice-coil material	Voice coil dia., in.	Power capacity, watts	Depth, in.	Weight, lbs.	Efficiency, EIA	Price	NOTES
VITAVOX	K15/40	Woofer	15	30-5k	30	moldd paper	high	chem trtd.	Tic G	4 1/4	Cu. wire	2 1/4	50	8 1/4	23		135.00	available in full range at \$10 less
	DU121	full range coax	12 3	30-16k	30	paper plas.	high low	chem trtd.	Fer-oba 2	3	Cu. Cu.	1 3/4	30	6	16		95.00	compat. to lg. or small encls.
	AK124	full range coax	12	30-13k	35	paper	med.	chem trtd.	Fer-oba 2	3	Cu.	1 3/4	30	6	15		85.00	compat. to lg. or small encls.
	S2	driver		200-16k		alum alloy			aniso-tropic			1 1/4	10	5 3/4	13 1/2		160.00	requires hom & 500-cps x-over
WOLVERINE	L58	full range coax	8	45-14k	75	paper	med.	cone paper	Al V	6.8 oz.	Al. wire	2	40 pk	3 1/2	4 1/2	4.3	20.00	
	LS12	full range coax	12	40-14k	65	paper	med.	cone paper	cer	13 oz.	Al. wire	2	40 pk	3 1/2	5 1/2	4.5	21.00	
	LS15	full range coax	15	35-14k	50	paper	med.	cone paper	cer	13 oz.	Al. wire	2	40 pk	6 1/2	9	4.7	28.00	
	MC8	full range coax	8	50-13k	75	paper	med.	cone paper	cer	6 oz.	Al. wire	1	24 pk	3 1/8	4	4.2	14.00	
	LT12	full range 3-way	12	40-18k	60	paper phen.	med. low	paper phen.	cer A V	13 1.47 oz.	Al. wire	2 1	40 pk	5 1/4	8	4.7	36.00	

PRODUCT PREVIEW SECTION — *RECORD CHANGERS*



DUAL 1009



GARRARD LAB-80



BENJAMIN MIRACORD PW-40



THORENS TD-224

MANUFACTURER	MODEL NO.	Speeds		Platter dia., in.	Platter weight, lbs.	Wow %, 33 1/3	Flutter %, 33 1/3	Anti-skip from photo stylus in.	Anti-tracking error	Arm material	Cartridge weight range, gms.	Stylus force range, gms.	Cartridge mtg., type	Arm resonance, cps	Max. stack records	Change cycle, sec.	Above, in.	Below, in.	Motor board circ.	Dimen			Over-all height, in.	Weight, lbs.	Price	NOTES
		Variable	3 %																	Width, in.	Depth, in.					
DUAL	1009	4 6	10%	7 1/4	.04	.03	8	1.5 4.5	A C	2-16	1/2-7	Lock in Shell	8	10	13	6 1/2	3	12%	11 1/2	9 1/2	15	99.50		Automatic and manual start		
	1010	4	10%	3 1/2	.04	.03	8	1.8 4.5	A S	7-14	2-7	Shell	12	10	13	6 1/2	3	12%	11 1/2	9 1/2	10 1/2	69.50		Automatic and manual start		
GARRARD	Lab 80	4	10%	6	.10	.02	9.0		A C	4-18	1/4-5	Plug in Shell	10	8	10	5 1/2	3 1/2	17	14%	9	16 1/2	99.50				
	Type A70	4	10%	6	.12	.05	8.5		A C	4-18	1/4-5	Plug in Shell	15	8	10	6	2%	16%	14%	8%	16	84.50				
	AT60	4	10%	4	.14	.05	7.5		A C	4-22	1/2-5	Plug in Shell	15	7	10	4	2%	15%	1.3%	7%	10	59.50				
	Model 50	4	10%	2 1/4	.14	.05	7.5		A S	4-18	1/2-8	Plug in Shell	20	7	10	4	2%	14%	12%	7 1/2	9	44.50				
MIRACORD	PW-40	4	12	6	0.1	0.1	8		A C		0-6	Plug in Shell	10	10	5	2 1/2	14%	12%	7%	16	89.50					
	PW-10H	4	12	6	0.1	0.1	8 1/2		S G		0-10	Plug in Shell	10	10	5	3	14%	12%	7%	11	99.50		Hysteresis Synch. motor			
THORENS	TD 224	4 3	12	7 1/4	0.15	0.05	8 7/32	3.05 12	A C	5-19	1-8	Plug in Shell	8	8	20	5 1/2	3 1/2	26	16%	9	24 1/2	250.00				

LOUDSPEAKERS in Enclosures-1

MANUFACTURER	MODEL NO.	Woofer			Mid-range		Tweeter		Enclosure Dimensions			Tweeter type dispers ion, deg.	Wood finish	Grille mat'l color	Over-all freq. resp. ± db	Efficiency, E/A	Crossover type frequencies	Impedance, ohms	Weight, lbs.	Price	NOTES				
		Diameter, in.	Resonance	Cone material	Diameter, in.	Type	Dia. mat'l	Diameter, in.	Type	Dia. mat'l	Width, in.											Depth, in.	Height, in.		
ACOUSTECH	X	12 ft ²	ES		ES		26 3/4	4	72	ES	wal	boucle neutral				1300	225	1690.00		full range electrostatic 12 sq. ft. woofer					
ACOUSTICA	100	6 41	stiff paper	—	15" cyl	plas	—	—	42	ES 360°	wht wal	boucle oys wht	60-30k		LC 300	8 15	229.50		360° dispersion						
	300	6 41	stiff paper	—	18" cyl	plas	—	—	19	ES		boucle oys wht	35-30k		LC 300	8 24	199.50		360° dispersion						
	400	6 41	stiff paper	—	13" cyl	plas	—	—	19	ES		boucle oys wht	50-30k		LC 300	8 16	169.50		360° dispersion						
	510	12 16	stiff paper	—	15" cyl	plas	—	—	25	ES	wal	bamboo brn wve	30-30k		LC 300	8 60	239.50		360° dispersion						
	520	12 16	stiff paper	—	15" cyl	plas	—	—	25	ES	wht & wal	bamboo brn wve	30-30k		LC 300	8 70	289.50		360° dispersion						
ACOUSTIC RESEARCH	AR-3	12 44	fltd paper	2 dome	phen 1 1/2 dome	phen	25	11 1/2	14		wal mah bir, etc. for all mods	saran off wt	on req.		LC 1000 7500	4 50	203.00 to 225.00		acous susp woofer						
	AR-2a ^x	10 57	fltd paper	3 cone	paper 1 1/2 dome	phen	24	11 1/2	13 1/2			burlap beige	on req.		LC 1750 7500	8 36	109.00 to 128.00		acous susp woofer						
	AR-2 ^x	10 57	fltd paper	—	3 1/2 cone	paper	24	11 1/2	13 1/2			burlap beige	on req.		LC 1750	8 32	89.00 to 102.00		acous susp woofer						
	AR-4	8 68	fltd paper	—	3 1/2 cone	paper	19	9	10			burlap beige	on req.		LC 1750	8 17	51.00 to 57.00		acous susp woofer						
AUDIO DYNAMICS	ADC18	rect drvr			1 1/2 dome	Mylar	17	12 1/2	40		oil wal		20-20k 3		LC 1000 to 8/4000	8/16	250.00								
	ADC-303A	rect drvr			1 1/2 dome	Mylar	13	11 1/4	22 1/4		oil wal		35-20k 3		1000 to 8/4000	8/16	34 95.00								
	ADC-325	rect drvr			2 cone	paper	19	8	10 1/2		oil wal		45-20k 4		LC	8 19	49.50								
ALTEC-LANSING	896A Valencia	15 25	mldd fibre	Sectoral alum horn 10" h x 25" w x 18" d in all these models							90° x 40°	wal	wood network walnut	30-22k	109	2 sect	800	8/16	115						
	A7W Voice of the theatre	15 25	mldd fibre													wal		35-22k	109	2 sect	800	8/16	159	372.00	
	838B Carnel	2x 12	30 mldd fibre									35	17 1/4	25 1/4		wal	boucle beige	30-22k	109	2 sect	800	8/16	117	396.50	
	843A Malibu	2x 12	30 mldd fibre									25	18	40	90° x 40°	wal	boucle beige	30-22k	109	2 sect	800	8/16	120	365.00	
	845A Verde	8 55	mldd fibre							5 cone		23	11 1/4	11 1/4		wal	plas brown	45-18k	90	2 sect	2000	8/16	30	96.00	
AMPEX	813			6x9 cone			9	5	7			cloth dk brn	70-13k				8 3	29.95pr		spkrs fasten & lock to mod. 800 transport dec					
	2010	8 70	stiff paper		3 1/2	paper				90	wal	cane & chrc l	50-15k		RC 2000	8	79.95								
	3010	10 60	stiff paper		2 x 3 1/2	paper	28 1/2	11 1/2	18 1/2	90	wal	cane fabric	30-15k		RC 2000	8	159.95								
	815	6 70	stiff paper		3 1/2	paper	9 1/2	13 1/2	7 1/2	90	wal	brn or gray	50-15k		RC 2000	8	64.95pr								
	1110	5	stiff paper cloth susp.	5	paper	2 1/2	paper	19	7	13	90	vinyl clad wood	70-15k		RC 4000	8	149.95pr		stereo spkrs fasten together as suitcase						
BENJAMIN	208	8 70	paper		3 cone	paper	21 1/4	9	12	cone	wal brn		30-20k		LC 2500	8 25	49.50								

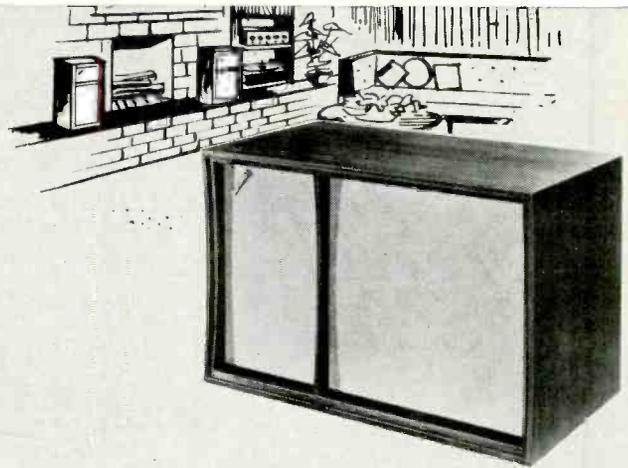
HEAR Wharfedale



W90 shown on optional mounting base

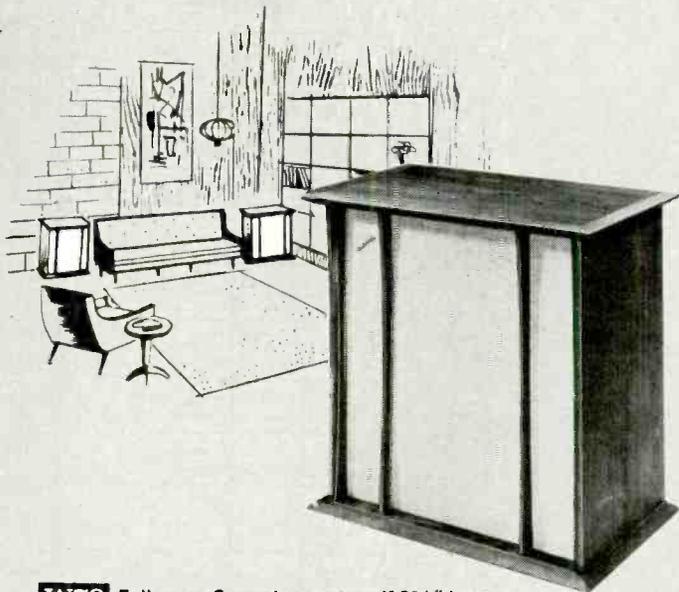
W90 6-speaker system (two 12½" bass, two 5½" mid-range, two Super 3 treble), superbly matched and integrated with a magnificent sand-filled enclosure.

The impact of the great Wharfedale systems used in G. A. Briggs' notable live vs. recorded demonstrations, now in a new format—neither compact nor large, to sound well and look well in any living room. Maximum performance through advanced acoustical techniques—speakers with polystyrene facing—enclosures with tuned and distributed ports. Now restyled with decorator bouclé fabric grille and handsomely finished top. Oiled or Polished Walnut, \$272.50; Utility model, \$256.50.



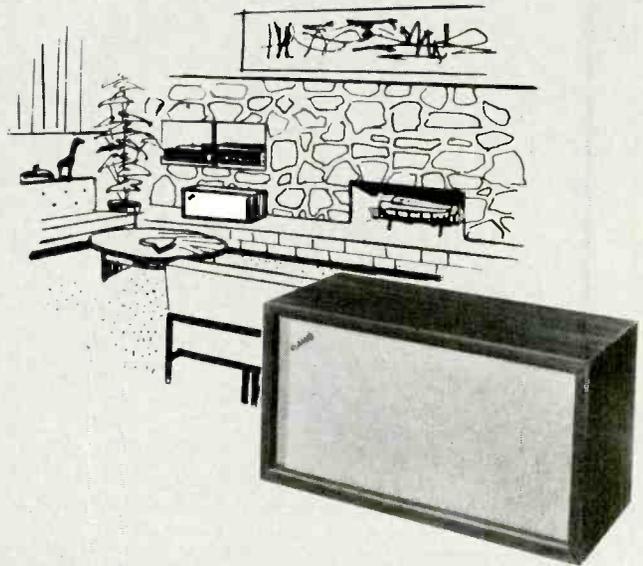
W60 Full-range 2-speaker system (12½" bass; 5" mid-range tweeter) in exclusive sand-filled enclosure.

The original Achromatic system, W60 continues to be the most popular Wharfedale model. Its high standing was established by comparative tests against speaker systems of every calibre. New magnetic materials, a more compliant cone surround, and other developments have now added luster to its recognized acoustical qualities. Fine furniture detailing, including new decorator-selected champagne bouclé grille fabric. Oiled or Polished Walnut, \$122.50; Utility model, \$106.50.



W70 Full-range 3-speaker system (12½" bass; 10¼" mid-range; Super 3 treble) in exclusive sand-filled enclosure.

An unusually versatile system providing excellent bass, transparent highs and the fullness of a superb mid-range. Recent technical advances make it compatible with the latest electronic equipment, including solid state. Now restyled with champagne bouclé grille and decorative table top and base... an attractive addition to any listening room. Oiled or Polished Walnut, \$172.50; Utility model, \$153.50.



W40 Full-range 2-speaker system (10½" low frequency; 5" mid-range tweeter) in exclusive sand-filled enclosure.

Now, W40 incorporates a highly advanced 10½" bass speaker with extremely high flux density magnet, providing excellent low end. Highs are reproduced without stridency through the same cone-type, 5" tweeter as in the W60. Restyled with distinctive champagne bouclé grille and decorative molding, it is admirably suited to any music system where space must be carefully utilized, but quality is required. Oiled or Polished Walnut, \$83.50; Utility model, \$72.50.

WHARFEDALE COMPONENT LOUDSPEAKERS

Full Range 8" Super 8	Full Range 10" Super 10	Full Range 12" Super 12	Woofer W 12/RS	Woofer W 15/RS	Tweeter Super 3
RS/DD \$26.50	RS/DD \$47.50	RS/DD \$89.50	\$52.50	\$89.50	\$26.50

READ
Color Comparator Guide and list of dealers

Mail this coupon to Wharfedale, Dept. WK-15, Div. British Industries Corp., Westbury, New York 1159

Name _____
Address _____
City _____ State _____

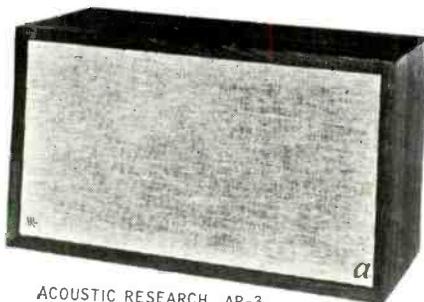
LOUDSPEAKERS in Enclosures-2

MANUFACTURER	MODEL NO.	Diameter, in.		Woofer	Mid-range		Tweeter		Enclosure Dimensions			Tweeter type dispersion deg.	Wood finish	Grille mat'l color	Over-all freq. resp. ±	Efficiency, EIA	Crossover type	Crossover frequencies	Impedance, ohms	Weight, lbs.	Price	NOTES
		Resonance	Cone material	Diameter, in.	Type	Dia. mat'l	Diameter, in.	Type	Dia. mat'l	Width, in.	Depth, in.											
BOZAK	B-312	12	35	paper	-	-	2 cone	alum	24	12½	17¼	cone 120°	wal mah	wht linen	45-16k	RC	2500	8	60	147.50		
	B-313	12	35	paper	6	met'l	2 cone	alum	24	12	17¼	cone 120°	wal mah	wht linen	45-16k	LC	800 2500	8	60	197.50		
	Urban B-300	12	35	paper	-	-	2 cone	alum	24	20	30¼	cone 120°	wal mah	wht linen	40-16k 6	RC	2500	8	90	179.50		
	Urban B-302A	12	35	paper	6	met'l	2 cone	alum	24	20	30¼	cone 120°	wal mah	wht linen	40-16k	RC	800 2500	8	100	261.50		
	B-4000	12	35	paper	8	met'l	2 cone	alum	28	16	44	line 150°	wal mah	wht linen	35-16k 4	LC	200 1500	8	150	495.00		
ELECTRO-VOICE	E-V SEVEN	8		paper			3½ cone	paper	19	9	10	cone 90°	oil wal	cane nat'l	50-15k	RLC	2000	8	19	65.00	acous. susp. woofer	
	E-V FIVE	10		paper	-	-	3½ cone	paper	25	12	14	cone 90°	oil wal	cane nat'l	30-15k	RLC	1000	8	38	108.00	acous. susp. woofer	
	E-V SIX	18		plas foam	8 cone	lexan	horn	phen	32	17½	30	horn 120°	wal mah frtw	cane nat'l	30-20k	RLC	250 800 3500	8	107	333.00	acous. susp. woofer	
	Patrician 800	30		plas foam	12 cone	MR-horn phen	horn	phen	33	27¼	51	horn 120°	wal mah frtw	cane nat'l	30-23k	LC	100 800 3500	16	270	995.00	4-way sys. cont. & traditional styling	
	Sonocaster I	8		trtd paper					17	5½	16¼		steel gray	met'l blk	70-13k			8	6	25.00	molded housing; w/proo outdoor spkr	
EMPIRE	8000	12	25	midd paper	4½ cone	phen lam	1	phen lam	15	¼	29	dome 120°	wal		30-20k	LC *	450 5000	8	65	185.00	lam. polyester surface 2-sect + acous	
	8000P	12	25	"	"	"	"	"	16	dia.	29	"	"	-	25-20k	52	"	8	70	235.00	"	
	8200	12	25	"	"	"	"	"	23	¼	14	"	"	beige	30-20k	52	"	8	65	185.00	"	
	8400	12	25	"	"	"	"	"	25	12¼	13¼	"	"	-	25-20k	52	"	8	70	205.00	"	
	9000M	15	20	"	"	"	"	"	22	dia.	29	"	"	-	20-20k	52	"	8	120	285.00	" imp. marble top; w/wal top, 9000	
FISHER	XP-5	8	25	paper			2 cone	fib+ poly	20	9	10	cone 90°	bir wal	cane wal	38-18.5k	LC	2000	8	15	54.50 59.50	2 = woofer magnet birch is unfinished	
	XP-6	10	20/22	paper	5 cone	paper	1½ dome	cloth	23	10½	13	dome 120°	wal	plas wal	35-20k	LC	300 2500	8	35	99.50	mounting base avail.	
	XP-7	12	18/20	paper	2-5" cones	paper	1½ dome	cloth	24	12	14	dome 120°	wal	plas wal	30-20k	LC	300 2500	8	45	139.50	mounting base avail.	
	XP-9	12	16/18	paper	3-5" cones	paper	1½ dome	cloth	24	12	14	dome 120°	wal	plas wal	28-22k	LC	300 2500	8	55	199.50	mounting base avail.	
	XP-10	15	18/19	paper	8 cone	paper	2 dome	cloth	24	14¼	30½	dome 120°	wal	plas wal	28-28k	LC	200 2500	8	80	249.50	sep. ctrls for mid- and tweeter	
FRAZIER Super Dixielander	F-707-1037	10	28/32	paper	-	-	wood horn	alum	22	15¼	26½	horn 90°	util wal	cane	35-18k 5	116	LC	800	8	66	260.00 375.00	eqpt. cab. matching, \$250.00
	F-12-2-5T Mark V	12	25	paper	5¼ cone	-	horn drv	phen	14	12	26½	horn 90°	util wal	cane	30-17k 5	LC	200 3300	16	54	144.95 174.95		
	F8-3B Del Mar	8	38/42	paper	-	-	3 cone		23	7½	23¾	360°	util wal	cane	40-15k 5	fltr	3300	8	40	63.00 89.50		
	F8-3M-B Manhattan	8	38/42	paper	-	-	3 cone		23	7½	23¾	360°	wal	cane	40-15k 5	fltr	3300	8	45	99.50	includes base	
	F5-2 Super Midget	5		paper	-	-	-	-	15	9½	7¼		wal bir	cane	52-12k 5				8	11	29.95 26.95	
HARTLEY	Concert-Master	18	17	poly-mer	10 cone	poly-mer	3 cone	poly-mer	29	16	38	180°	oil wal	bskt wve	16-20k 3	LC	350	16	150	495.00 525.00	Modern Mediterranean	
	Holton	10	21	poly-mer			3 coax	poly-mer	24	14	34	180°	oil wal	cane	30-20k 3	v.c.	2000	8	85	245.00	Modern or traditional uses 220MS spkr.	
	Holton Jr.	"	"	"			"	"	15	13	30	"	"	"	40-20k 3	"	"	8	45	195.00 155.00 135.00	with 220MS spkr with 312 spkr with 310 spkr (see spec)	
	Capri	"	"	"			"	"	24	13	12	"	"	"	50-20k 3	"	"	8	35	180.00 130.00	with 220MS spkr with 310 spkr	

LOUDSPEAKERS in Enclosures



SCHOBER ORGAN LSS 10



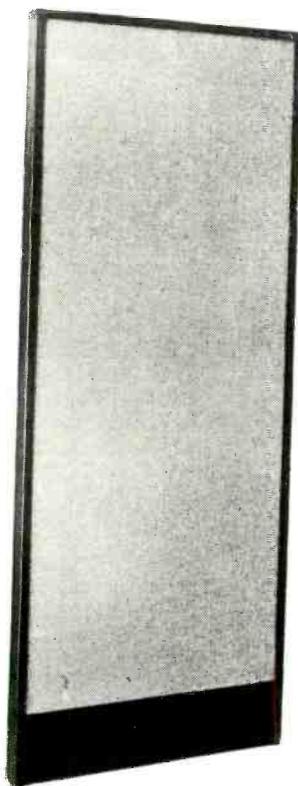
ACOUSTIC RESEARCH AR-3



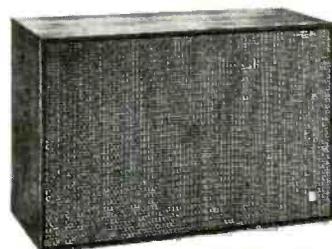
SHERWOOD SR-4



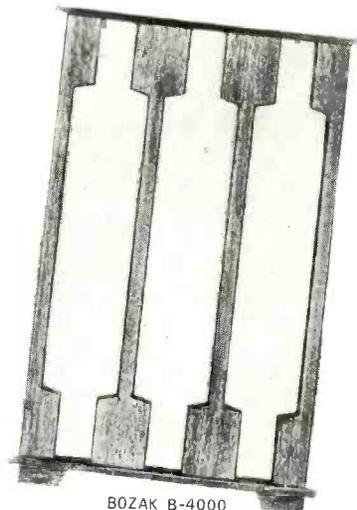
LEAK Mark II



ACOUSTECH X



JENSEN 600-XL



BOZAK B-4000



ALTEC 846A



WHARFEDALE W90



QUAD Electrostatic

LOUDSPEAKERS in Enclosures-3

MANUFACTURER	MODEL NO.	Diameter, in.		Woofer		Mid-range		Tweeter		Enclosure Dimensions			Tweeter type / dispersion, deg.	Wood finish	Grille mat'l / color	Overall freq. resp. ± db	Efficiency, EIA	Crossover type	Crossover frequencies	Impedance, ohms	Weight, lbs.	Price	NOTES
		Resonance	Cone material	Diameter, in.	Type	Dia. mat'l	Type	Dia. mat'l	Type	Depth, in.	Height, in.												
HEATH	AS-21	2x12				1	drv	32	19	32½		wal			30-22k	ens "k"	800	16	98	239.95			
	AS-10	10	58			2-3½	cones	24	11½	13½		unf/wal			30-15k6	LC	2250	16	28	59.95	acous. susp.		
	AS-2A	10	58	2-5"	cpnes	1¾	dome	24	11½	13½		unf/wal			40-20k5	LC	20007500	8	36	89.95	acous. susp.		
JENSEN	PR-200	12	20	paper	2 dome	plas	1 dome	plas	25	11	14	120°	wal	rattan	25-20k	90°*	10005000	8		179.50	full elec. x-overs		
	PR-300	12	20	paper	2 dome	plas	1 dome	plas	25	14	18	120°	wal	rattan	25-20k	90°*	10005000	8		225.50	full elec. x-overs		
	600XL	12	15	paper	horn	plas	horn dome	plas	25	11	16	120°	wal	rattan	25-20k	180°*	600400010k	8		269.50	full elec. x-overs		
	TF-4	10	30	paper	8	paper	2-3½1-3	paper plas	25	9	16	120°	wal	rattan or wvn	25-20k	90°*	60040009000	8	12	129.50	full elec. x-overs		
	PR-400	15	15	paper	2 dome	plas	1 dome	plas	34	14	29	120°	wal	tex cloth	20-20k	90°*	10005000	8	76	297.50	full elec. x-overs		
JORDAN-WATTS		4	40	alumi	—	—	—	—	13½	7½	30	30°	wal mah	brn	40-18k				16	40	180.00		
KLH	9	ES				ES			70	2%	23½		wal oil w mah	boucle wht		—	—	16	155	1140.00	ster pr.	full-range electrostatic	
	14-B	2-3"	stiff paper	full range	—	—	—	14	8½	8			oil wal	boucle wht		—	—	8	15	49.50		fin. 4 sides full-range spkrs	
	17	10	stiff paper			1¾	cone	paper	23½	9	11½		oil wal	boucle wht		RC	1500	8	28	69.95		fin. 4 sides acous. susp. spkr	
	4	12	stiff paper	—	—	2-1¾	cones	paper	25	12	13½		wal oil w mah	boucle wht		RC	1500	16	42	231.00		fin. 4 sides; acous susp also in unf. birch	
	6	12	stiff paper	—	—	1¾	cone	paper	23½	11%	12%		wal oil w mah	boucle wht		RC	1500	8	36	134.00		fin. 4 sides; acous susp also in unf. birch	
KSC SYSTEMS	1	10	35	stiff paper	3½ cone	stiff paper	3½ cone	stiff paper	12	12½	20	90°	oil wal	cane tan & gold	50-20k3	med high	LC	7503500	8	28	89.95 to 105.00	shelf mtg. type also unf. birch or fir	
	2	10	36	stiff paper	—	—	3½ cone	stiff paper	12	12½	20	90°	oil w	boucle sand & gld	45-20k4	med high	LC	1500	4	27	79.50	shelf mtg. type	
	3	10	34	stiff paper	6 cone	stiff paper	3½ cone	stiff paper	13	13½	30	360°	oil w	boucle sand	35-20k2	med high	LC	7003000	8	43	195.00	floor type; 360° diff & reflecting system	
KARLSON	X-15	15	16 mtd	paper	—	—	3 K cpld	paper	20	14%	28	Krlsn 160°	wal bir	cane buff	12-20k4		RC	1500	8	95	249.50	footings furnished	
KELLY	Labyrinth	12	25	imp. paper	—	—	ribbor	alumi	24	12	36	rib'n 30°	wal	bm	25-22k2		RC	2500	16	200	375.00	studio monitor	
	Parva	12	25	imp. paper			2 ribbor	alumi	18	12	30	rib'n 30°	wal	bm	40-22k2		RC	2500	16	100	250.00	home use	
LAFAYETTE	Criterion 20	4	54	rubzd cloth	—	—	4 cone		11¾	7%	5%	cone	wal	wht gold	45-20k		LC	2800	8	6	24.95	filled w/ acous mat'l	
	Criterion 50	8	50	stiff paper			stiff paper	4 cone	19	8%	10%	cone	wal	wht gold	30-18k		LC	3000	8	9	29.95		
	Criterion 100	10	45	stiff paper			stiff paper	4 cone	19	8%	10%	cone	wal	wht gold	25-19k		LC	2800	8	25	49.95		
	Criterion	12	40	foam trtd paper	8 cone	stiff paper	3 dome	alumi	24	12	14	dome	wal	wht gold	25-25k		LC	7005000	8	30	69.95		

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in period—**

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changes—**

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jobs—**

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sand mile
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A new guarantee for an outstanding new compact loudspeaker. The 1965 Jensen Model PR-200 is an engineering triumph. The "power plant" within the beautifully crafted oiled walnut cabinet is a skillfully engineered 3-speaker, 3-way system with a 12-inch woofer.

Three famous, exclusive Jensen loudspeakers faithfully reproduce every sound in the 25 to 20,000 cycle frequency range. Contemporary wrap-around fabric of textured rattan compliments the beauty and sophistication of fine Jensen craftsmanship.

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*whichever comes first



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Circle 131 on Reader Service Card

LOUDSPEAKERS in Enclosures - 4

MANUFACTURER	MODEL NO.	Diameter, in.		Woofer		Mid-range		Tweeter		Enclosure Dimensions			Tweeter Type		Wood Finish		Over-all freq. resp. ± db	Efficiency, EIA	Crossover Type	Crossover Frequencies	Impedance, ohms	Weight, lbs.	Price	NOTES
		Resonance	Cone material	Diameter, in.	Type	Dia. mat'l	Diameter, in.	Type	Dia. mat'l	Width, in.	Depth, in.	Height, in.	Type	dispersion, deg.	Wood finish color	Grille mat'l								
LANSING (JBL)	D56S12	14	25	paper	Lans a-plas	—	—	2 dir. rad	paper	17 1/2	12 1/4	24	dir. rad. 90°	oil wal	beige or blk		43	LC	1000	8	70	231.00	marble top	
LEAK	Mark II Sandwich	13	19	*	—	—	3 1/4	*	15	12	26	60°	wal	gldn bm	30-18k3	55	LC	900	15	49	199.00	* sandwich const. polystyrene foam betw. alum skins. Fin. all sides		
PIONEER	CS-A50	12	15	paper	5 cone	paper	2 1/2 drvr	alum	15 3/8	12 3/4	26	100° *	oil wal	gold cloth	30-20k6		LC	700 3500	8	45		*horn and cone; 60-w input; 3 tweeters		
	CS-A31	12	50	paper	5 cone	paper	2 drvr	Mylar	15	12 3/4	26	100° *	oil wal	gold cloth	40-20k6		LC	800 6000	16	34		*horn and cone; 40-w input		
	CS-51	5	60	paper	—	—	2 1/2 cone	paper	5 7/8	6 1/4	9 1/2	cone 100°	oil wal	perf met'l	50-20k6		LC	4500	16	9		perf met'l in gold or blk 20-w input		
QUAD	QUAD Electrostatic	ES		plas	—	—	ES			3 1/4	10 1/4	31	—	beech bmz	45-18k		—	—			35	260.00	full-range electrostatic	
RADFORD	Monitor	12	25	poly	4	paper	2 pres		15	11 1/2	25	30°	wal	brn	40-22k		RC	600 3000	16	38	270.00			
SCHOBER ORGAN	LSS-10	12	32	hvy paper	—	—	8 cone	hvy paper	24	19	36		wal	cloth beige	32-13k5	49	LC	250	8/16	80	150.00 69.50	std. wal. fin; dir from mfr. only. w/o cab; const. plans furn.		
	LSS-100	15	32	hvy paper	8 cone	hvy paper	1,2 horns	phen	29 1/4	22	47	horns 180° ea	wal	cloth beige	32-20k4	54	LC	250 1000 3500	16	140	300.00	available dir. from mfr only		
	RV-3C	12	32	hvy paper	—	—	—	—	24	12	34		wal	cloth beige	32-13k6	49	—	—	16	85	555.00	reverb. tone cab; incl. Schober Reverbatape + 40-w s/s ampl. Avail. only through dealers		
SCOTT	S-2	12	25	stiff paper	2-5 cones	paper	1 dome	phen	14 1/4	12 1/4	23 1/2	dome 100°	mah wal	boucle beige	40-20k6	46	LC *	700 8000	8	45	199.95	* x-over slope 18 db/octave		
	S-5	6	42	stiff paper	—	—	3 cone	paper	16	6 3/8	10		oil wal	vinyl beige	45-15k6	46	LC *	2000	8	15	59.95	* x-over slope 12 db/octave		
SHERWOOD	SR4 Tanglewood	2-10	17	paper felt	8 cone	paper	2-3 1/4 rings	paper	24	13	21	ring 180°	wal bir	cane beige	29-17.5k2.5		RC	200 600 3500	8	73	219.50	rear-loaded woofers		
	SR3 Ravinia	12	21	paper felt	8 cone	paper	3 1/4 ring	paper	25	13	15	ring 160°	wal bir	cane beige	48-17.5k2.5		RC	600 3500	8	55	139.50	base available		
	SR2 Berkshire	10	23	paper felt	8 cone	paper	3 1/4 ring	paper	24	9 1/4	13	ring 160°	wal bir	cane beige	53-17.5k2.5		RC	600 3500	8	36	99.50	base available		
	SR1 Newport	10	23	paper felt	—	—	4 cone	paper	24	9 1/4	13	cone 140°	wal bir	cane beige	53-17.5k2.5		RC	1800	8	30	84.50	base available		
SONOTONE	RM-0.5	4	75	stiff paper	—	—	2 cone	stiff paper	7 1/4	7	10 1/2	cone	oil wal	cane bm	55-20k	37	LC	5000	8	8	39.75	h.f. level control		
	RM-1	6	50	stiff paper	—	—	2 cone	stiff paper	10 1/4	7 1/4	14 1/2	cone	oil wal	cane bm	45-20k	39	LC	5000	8	12	44.50	h.f. level control		
	RM-2	8	50	stiff paper	—	—	3 1/2 cone	stiff paper	11 1/4	8 3/4	19	cone	oil wal	cane bm	40-20k	41	LC	4500	8	22	56.50	h.f. level control		
	SE-80	8		stiff paper	—	—	2 cone	stiff paper	12 1/4	11 1/2	20 1/2	cone	oil wal	cane bm	45-20k	46	*	6000	8	27	49.75	dual concentric mech. x-over		
	SE-880	2-8		stiff paper	—	—	2 cone	stiff paper	17 1/2	11	24	cone	oil wal		45-20k	49	*	6000	8	36	69.75	dual concentric mech. x-over		

LETTERS (from page 6)

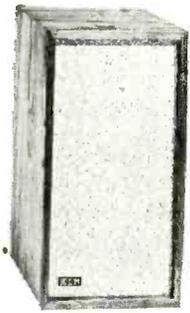
ment my existing bass, horn-loaded, speakers. Even with the best of woofers there is an audible droop at the bottom end of the sound spectrum and I feel that adding additional speaker power for the very bottom is a preferable solution. The bass energizer concept could be included in the system's tone controls. It is air-moving-surface power that is needed.

With a very simple electronic crossover it is possible to mix

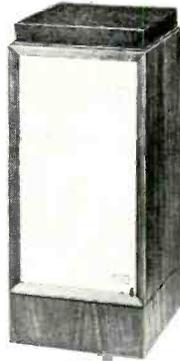
both stereo sources and tailor a satisfactory common woofer bass for the added boost. I found an 11.5-db-per-octave crossover, peaking the bass in the 40-cycle region, relatively satisfactory on my well damped auxiliary woofer.

VICTOR REITER, JR.
1195 Stanyan Street
San Francisco 17, California

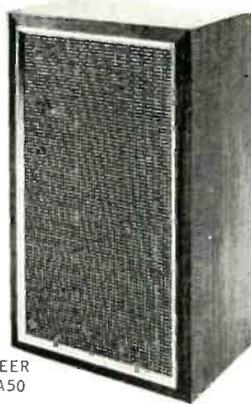
LOUDSPEAKERS in Enclosures



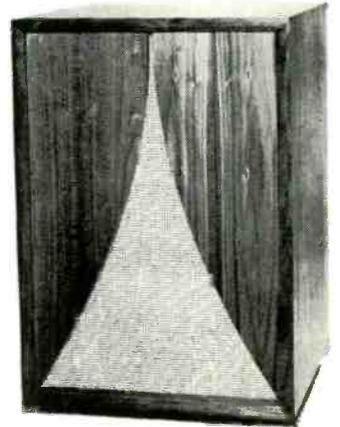
KLH SIX



KSC 3



PIONEER CS-A50



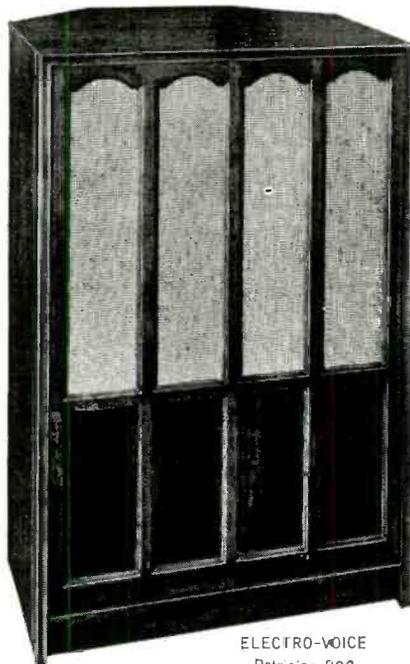
KARLSON X-15



WHITECREST



ACOUSTICA



ELECTRO-VOICE Patrician 800



SONOTONE



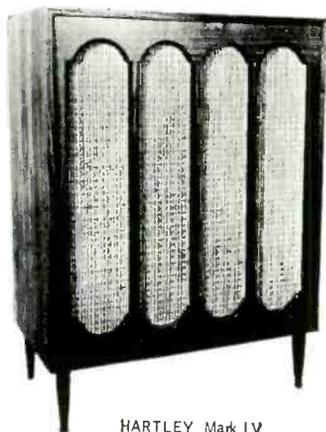
AMPEX 3010



FISHER XP-7



UTC SQUID Maximus 7



HARTLEY Mark IV



HEATHKIT AS-21



JBL D56S12

The Tape Guide

HERMAN BURSTEIN

Send questions to:

Herman Burstein
280 Twin Lane E.
Wantagh, N. Y.

Include stamped, self-addressed
envelope.

Impedance of Playback Head

Q. Channel 1 of the playback head of my stereo tape recorder has an intermittent open coil, and I wish to replace it with a head of another make. However, I am not sure about the impedance of the original head. The service manual is badly printed, and if my deciphering is correct, it seems to say that the playback head impedance is 2.55 millihenries.

A. This low an impedance is unlikely for a playback head. The impedance is probably 255 millihenries.

Recording Overloads

Q. About a year ago I purchased a tape recorder. I have tried to make several live recordings, but the problem seems to be that the recorder overloads too easily if I set the gain control high enough to capture the low-level sounds. On the other hand the recorder seems to act pretty normal on off the air recordings. Any suggestions?

A. It happens that I have had the opportunity to check out the tape recorder to which you refer. My experience plus several equipment reviews in various magazines indicate that this machine has one of the poorest signal-to-noise ratios you are likely to encounter. I measured only 38 db signal to noise ratio, while a good machine will attain 50 to 55 db. Therefore if you record at a level high enough to get the quietest sounds distinctly above the noise produced in playback by this machine, the loudest sounds will be recorded at a level so great as to cause excessive distortion on the tape.

The problem is less with off the air recording because you are then dealing with a compressed dynamic range, perhaps of the order of 40 or 45 db; the

compression is applied by the studio engineers and/or the engineers who produced the phono disc or tape that is being broadcast. When you are recording live, the dynamic range may be as great as 55 to 65 db, to that there is much greater chance of over-recording the loudest sounds.

Your problem is aggravated by the fact that your particular tape recorder uses vu meters (or something akin to them) rather than magic eyes as the record level indicators. The meter tends to understate peak recording level by 10 db or more, so that you may be unwittingly overloading the tape. Experience and judgment are necessary when using a meter rather than a magic eye or neon lamp as the record level indicator. Accordingly, I suggest that you don't let the meter swing too close to the 0-vu mark when recording. I have no suggestion as to reducing the playback noise of your tape machine except to advise you to ask the manufacturer. This noise is principally hum, and he may have worked out a remedy.

M-S with Cardioid and Omni

Q. M-S (mid-side) stereo recording has been done with a forward-facing (cardioid) mike in combination with a side-facing (ribbon or figure-eight) mike, but has it ever been done to your knowledge with a combination of cardioid and omnidirectional mikes. If not, why not?

A. I am aware that M-S recording is done with separate mikes as well as with a combination mike. I am not aware of an omnidirectional and a cardioid mike being used together successfully. In theory, it seems this wouldn't work because a mike with a cosine (figure-eight) pattern is needed to provide the left and right components in opposite polarity. When mixed with the output of the cardioid mike (L plus R), the L-R output of the cosine mike produces either 2L or 2R, depending on which polarity of the cosine mike's output is used. Thus L plus R and L minus R produces 2L; while L plus R and R minus L produces 2R.

Bias and Recording Levels

Q. Being unable to make tape recordings that pleased me, I decided to check the adjustments described in the service manual for my machine. I found that both the bias and the recording levels measured only about half of the specified voltage, so I adjusted each according to the specifications. Could the machine have been adjusted this poorly at the factory, or could something else have caused me to get false voltage readings? The VTVM that I used for my measurements has seemed fairly accurate in the past in other radio and audio work. Can you suggest any other method of checking the bias and audio voltages?

A. Assuming your VTVM is accurate, one explanation of the differences you found between measured and specified voltages is that the manufacturer has changed heads but failed to change his service notes accordingly. Another explanation is that the manufacturer, because of the competitive pressure to claim extremely extended treble response, has deliberately under-biased his machine in order to do so. To offset the increased distortion due to decreased bias, he has also reduced recording level. But the lower recording level ultimately results in a poorer signal-to-noise ratio in playback.

I suggest the following: At 7.5 ips, with bias and recording level set as directed by the service manual, check record-playback response. If you have a signal generator, record at a level 20 db below the maximum permissible level as indicated by the record level indicator. If you have no signal generator, copy a phono disc with ample lows and highs, and play back the tape in synchronization with the disc through a good audio system. A-B the tape versus the disc. If the tape sounds substantially like the disc in terms of frequency response, without appreciable loss of highs, you can probably stop at this point. If there is an appreciable deficiency in treble, back down a little on the bias and repeat the test. Keep adjusting bias until the tape sounds like the disc as nearly as possible. (The appropriate amount of bias tends to vary somewhat from one brand of tape to another.) Measure the bias voltage. Adjust the recording voltage so that it bears the same ratio to the bias voltage as the specified recording voltage bears to the specified bias voltage. (A better technique, if you have a harmonic distortion meter, is to adjust recording level to produce 3 per cent harmonic distortion on a 400-cps tone; at this point the record level indicator should indicate maximum recording level if it is a magic eye or neon lamp; if it is a VU meter, it should read

(continued on page 92)

CONCORD "R" SERIES: FIRST TRULY NEW PROFESSIONAL TAPE RECORDERS IN 5 YEARS!

Several years ago, Concord engineers began design of a tape recorder to incorporate all the recent advances in electronic and electromechanical technology in a professional instrument without regard to cost.

The four basic considerations in the design of the "R" Series instruments were: 1. The recording quality, 2. The operating features, 3. The reproduction quality, 4. Rugged, reliable performance for heavy duty use. Here's how these objectives were achieved:

TAPE TRANSPORT MECHANISM: Three-motor design of the tape-transport mechanism provides fast tape handling (45 second rewind speed for standard reel).

Reliability: there are no rubber drive rollers or mechanical linkages which may be subject to deterioration. Reverse-play operation shows no measurable increase in wow and flutter.

All three motors are hysteresis synchronous, ensuring tape-speed accuracy regardless of line voltage fluctuations. The 24-pole slot-wound capstan-drive motor combines an electronically balanced rotor and newly designed double-thrust bearings to minimize motor end play and eliminate cogging.

The flutter-free performance of this new capstan-drive motor is in itself an engineering achievement of considerable magnitude. A dual winding allows the motor to operate at 3,600 rpm at 7½ ips and 1,800 rpm at 3¾ ips, permitting pushbutton speed change without mechanical rollers or idlers.

TAPE. Tensioning is achieved on the Concord "R" Series without pressure pads, using hyperbolically ground heads for maximum tape wrap. An electronic holdback tension circuit for each reel motor ensures optimum holdback in either direction of tape travel.

The tape path incorporates a precision-ground ball bearing flutter filter with a 30 oz. dynamically balanced flywheel. This system dampens minute amounts of mechanical flutter, preventing it from being recorded. The dynamically balanced 1.5 lb. capstan-drive flywheel is machined on a tape-controlled lathe for extreme dimensional accuracy. A special steel alloy (modified 17-4PH) was formulated to provide maximum flywheel mass and shaft strength as well as the hardness necessary for close-tolerance machining and grinding of the capstan.

The pressure roller consists of a precision-ground metal core with a molded-rubber facing designed for maximum tape friction and minimum wear. Pressure roller is easily removed for lubrication, cleaning, or special cueing.

"R" Series recorders feature automatic tape lifters, which remove the tape from direct contact with the heads in the fast-wind modes.

BRAKING. Solenoid-operated, self-

equalized brakes gently but firmly stop the tape from the fast-wind positions without stretching or tearing. These self-compensating brakes do not normally ever require adjustment.

CONTROL FUNCTIONS. The transport mechanism controls are all-pushbutton and operate the mechanical functions electronically. In the R-2000, an electronic memory circuit permits the user to push the fast-wind or play button in sequence which causes it to fast-wind, stop, automatically pause, and proceed to the play mode without further attention, either at the recorder or at the remote-control station. In the record mode, the R-2000 provides an automatic rewind safety function at the end of the reel to prevent accidental erasure. The recorder shuts off automatically after completion of rewind.

In the play mode, "R" Series tape recorders automatically reverse at reel end, play the tape in the opposite direction, and then automatically shut off.



CONCORD MODEL R-2000 with full remote-control — under \$800.

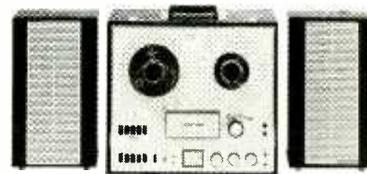
A remote-control console, included with the R-2000, provides full remote-control of all functions. R-1000 Series recorders have remote start-stop control for both play or record modes.

Cueing and editing is fast and convenient. The supply and take-up reels are readily rotated by hand with the recorder in the stop mode, and the heads are easily accessible for editing.

HEADS. All "R" Series recorders use professional low-impedance heads with laminated cores of a new mu-metal alloy, permitting minimum playback-head gap width and maximum frequency response. The record head has a wide gap for recording maximum signal. The erase head is of a new design, with a double gap and ferrite core to ensure maximum noise-free erasure.

"R" Series heads are selected in matched pairs with a tolerance of 1 db difference in channel output over the entire frequency range. A new, improved type of shielding has been developed, which reduces cross-talk to extremely low levels. The R-2000 has a

plug-in head assembly, making possible use of ½- or ¼-track configurations.



CONCORD MODEL R-1100 with optional start-stop remote-control plus solid-state power amplifiers and speakers — under \$500.

CONCORD MODEL R-1000 with optional start-stop remote-control — under \$450.

ELECTRONICS. All "R" Series recorders contain four preamplifiers, two for recording and two for playback. This design permits monitoring from the tape while recording as well as separate equalization adjustments for each of the record and playback preamplifiers. Recording amplifiers are easily adjusted for optimum record bias for the particular tape and tape speed. Bias adjustments are readily accessible.

All components and electronic assemblies are equivalent to MIL Spec requirements. Advanced-design circuitry permits professional quality recording with superior signal-to-noise ratio and frequency response. The R-2000 has facilities for plug-in microphone transformers with -90 db shielding for either high- or low-impedance, balanced or unbalanced line.

ELECTRONIC CONTROL. Separate controls for both line and microphone permit mixing of line and mike levels. A monitoring control provides immediate source-tape comparison at the same sound level while recording. Recorders have front-panel provision for creating sound-on-sound or multiple recording by pushing a button or moving a knob. No need to change inputs or outputs.

Reverberation and echo effects are created similarly. Record levels may be adjusted without tape movement, and safety interlocks prevent accidental recording.

PRECISION MANUFACTURE. Produced on a custom basis (two R-2000's and six R-1000's a day), each recorder undergoes 68 inspection checks during assembly before final inspection. Every "R" Series instrument undergoes a 72-hour continuous heat-run test with all controls continuously operated by an automatic programming device. After successful completion of this severe test, each unit is again 100% inspected before shipment.

The "R" Series Recorders are available now at Concord professional audio dealers throughout the United States and Canada.

For Connoisseurs of Sound

CONCORD

CONCORD  ELECTRONICS CORPORATION 1935 Armacost Avenue, Los Angeles, California 90025
IN CANADA: Magnasonic Industries, Ltd., Toronto/Montreal

THE SIGNATURE OF QUALITY ■ Tape Recorders/Industrial Sound Equipment
Dictation Systems/Communications Devices/Closed-Circuit Television

Circle 133 on Reader Service Card

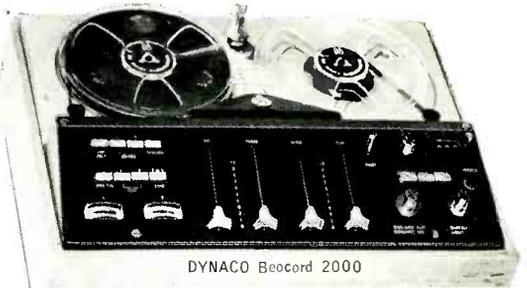
PRODUCT PREVIEW SECTION — **TAPE RECORDERS-2**



CROWN SS-801



CRAIG 520



DYNACO Beocord 2000

MANUFACTURER	MODEL NO.	Speeds	No. of heads	Head confinement	Tracks / mode	Playback fld. gap / fl. in.	No. of idlers	Type of motor(s)	Capsstan drive	Rewind & F-lwd drive	Max res. (size, in.)	Wow & flutter % / 7 1/2"	Wow & flutter % / 3 1/2"	Timing accuracy, %	Brill-in	Rewind	Leg. resp. / 1 sec.	Skt. freq. resp. / 1/2" ± db	Eq. resp. / 7 1/2" ± db	Pwr amp freq resp. / 2" ± db	Output Z	Width, in.	Depth, in.	Height, in.	Weight, lbs.	Mic. input Z, ohms	H.L. input Z, ohms	Mixing facility	Price	NOTES		
CONCORD	994	7 1/2 3 3/4 1 1/2	4	2RP 2E	4 S M	1	4p	belt	belts	7	0.15	0.23		120	40-16k 2	40-12k 3	55	20k	100k	yes	meter										auto. cont. p.b. and record, ster.	
	884	7 1/2 3 3/4 1 1/2	3	E R P	4 S M	1	4p	belt	belt	7	0.15	0.23		120	40-16k 1.5	40-12k 2	60	20k	100k	yes	meter										A-B monitor sw. 4 sep preamps snd-on-snd	
	R-2000	7 1/2 3 3/4	4	E R 2P	4 S M	117	3	hys	dir	dir	7	0.12	0.20	45	30-16k 2	40-12k 2	60	10k	100k	yes	meters										auto reverse	
	R-1100	7 1/2 3 3/4	4	E R 2P	4 S M	117	3	hys	dir	dir	7	0.15	0.20	45	40-16k 2	40-12k 3	55	10k	100k	yes	meters										auto reverse	
	R-1000	7 1/2 3 3/4	4	E R 2P	4 S M	117	3	hys	dir	dir	7	0.15	0.20	45	40-16k 2	40-12k 3	55	1k	16 7/8	14 1/2	46	2	ef								auto reverse	
CRAIG	520	3 3/4 1 1/2	2	E R P	2 M	150		d.c. gov	idler	idler (rew) belt (t.u.)	5		0.3	97	600' 180		200-7k 5	0.2	10k	100k	yes	5	meter								port. 4 "D" cells	
	525	3 3/4 1 1/2	2	E R P	2 M	150	1	4p	belt	belt	5		0.25	98	600' 100		120-7k 3	0.2524k	36k	yes	5	lamp									auto level cont.	
	910	7 1/2 3 3/4	2	E R P	4 S M	120	1	4p	belt	belt	7	0.2	0.25	98	150	50-15k 3	100-8k 3	50	0.2	10k	50k	yes	3	meter							snd on snd capability	
CROWN INT'L	SS722 SS724	7 1/2 3 3/4 1 1/2	3	E R P	2S 4S	40	3	4p & syn	belt	dir	10	0.09	0.18	99.8	38	50-25k 2	50-15k 2	54	0.3	100k	5k	yes	1.5	5" vu meters								all si. s/s; plug-in inp. & out. trans
	SS702	7 1/2 3 3/4 1 1/2	3	E R	2 M	40	3	4p & syn	belt	dir	10	0.09	0.18	99.8	38	50-25k 2	50-15k 2	54	0.3	100k	5k	no	1.5	5" vu meters							all si. s/s; plug-in inp. & out. trans	
	SS824	7 1/2 3 3/4 1 1/2	3	E R P	2S	40	3	4p & syn	belt	dir	10	0.09	0.18	99.8	38	30-30k 2	30-20k 2	50	0.3	100k	5k	yes	1.5	5" vu meters							all si. s/s; plug-in inp. & out. trans	
	SS822	15 7 1/2 3 3/4	3	E R P	2 S	50	3	4p & syn	belt	dir	10	0.09	0.18	99.8	38	30-20k 2	30-10k 2	56	0.3	100k	5k	yes	1.5	5" vu meters							all si. s/s; plug-in inp. & out. trans	
	SS801	15 7 1/2 3 3/4	3	E R P	1	50	3	4p & syn	belt	dir	10	0.09	0.18	99.8	38	30-20k 2	30-10k 2	56	0.3	100k	5k	no	1.5	5" vu							all si. s/s; plug-in inp. & out. trans	
DYNACO	Beocord 2000	7 1/2 3 3/4 1 1/2	3	E R P	4 S M	120		hys syn	idler	belt (rew) idler (f.f.)	7	0.2	0.3	99.5	90	40-16k	40-14k	50	50	200	100k	yes	1.0	meter							2-track model available	
															6	70-10k	30-15k	4	18	14 1/4	9	38	8	41						console portable		

TAPE RECORDERS-3



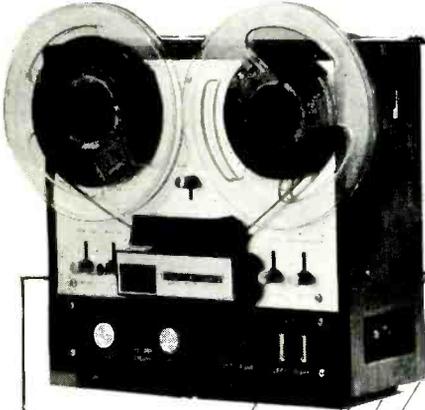
MAGNECORD 1028



LAFAYETTE 1000B

MANUFACTURER	MODEL NO.	Speeds	No. of heads	Head configuration	Tracks	Playback hdt. spds. f/m.	Type of motor(s)	Capstan drive	Rewind & F-ward drive	Max reel size, in.	Wow & flutter %	Wow & flutter %	Timing accuracy, %	Built-in amp, db	Rownd, 1200' / sec.	Spkr. freq. resp. / ± db	F req. resp. / ± db	Par amp freq resp. / ± db	Output Z	Width, in.	Depth, in.	Height, in.	Weight, lbs.	App. outputs, type & no.	Price	NOTES	
KNIGHT-KIT	KG-415	7 1/2 3 3/4	3	E R P	4 S M	100	4p	belt	dir (fwd) belt (rew)	7	0.2	0.3	98	90	50-18k 2	50-15k 2	50	1.5	3k	50k	yes	1.5	meters 2				
														no			low	14	9%	14 1/2	30	2	249.95				
KORTING	Bryan TK7	7 1/2 3 3/4 1 1/2	2	E R P	4 S M	1	2p	dir	dir	7	0.15	0.15	98	120	50-20k 3	50-12k 3	45	3	xtal	500k	yes		eye				
	4000	7 1/2 3 3/4 1 1/2	3	E R P	4 S	1	4p	idler	idler	7	0.15	0.25	99	120	30-18k 2	40-14k 2	50	70	200	2k 1m	yes		eye				
														2. 4x7			8	20	14	8	33	2	8w				
3000	7 1/2 3 3/4	2	E R P	4 S M	1	4p	idler	idler	7	0.15	0.25	99	120	30-18k 3	40-14k 3	40	80	200k	4.7k 1m	yes	eye						
LAFAYETTE	1000B	7 1/2 3 3/4	2	E R P	4 S M	1	4p	belt	dir	7	0.2	0.25	98	230	40-18k	40-12k	45		50k		yes	meter					
														2 6x4				17	12 1/2	7 1/2	37	2	199.95				
	RK-675	7 1/2 3 3/4	2	E R P	4 S M	1	4p	belt	dir	7	0.2	0.25	98	250	40-18k	40-12k	45		50k		yes	meter					
RK-137A	7 1/2 3 3/4	2	E R P	4 Spl M rec	1	ind	belt	belt & dir	7	0.2	0.3	98	180	40-15k	40-9k					no	meter						
													1 6x4				14	10%	6 1/2	18		89.50					
MAGNECORD	1024	7 1/2 3 3/4	3	E R P	4 S	100	3	syn 8p *	belt	dir	8	0.15	0.2	98	80	45-18k	35-10k	50	2	50k	150k	yes	1.0	meters		2-tk model avail *capstan - syn; reels - 8-p	
															no				ef	19	12%	15 1/2	47	4	648.00		
	1028	15 7 1/2	3	E R P	2 S	160	3	syn 8p	dir	dir	10	0.15	0.1 @ 15	98	45	35-16k	35-18k @ 15ips	55	1.0	50k	53k	no	1.0	meters		2-tk model avail *capstan - syn; reels - 8p	
1021	7 1/2 3 3/4	3	E R	1 M	100	3	syn 8p *	belt	dir	8	0.17	0.25	98	80	45-18k	35-8k	53	.04	150	160k	yes	1.0	meter		full-track model *capstan-syn; reels-8p		
																		600	19	12%	15 1/2	47	2	708.00			
NEWCOMB	TX-10-4	7 1/2 3 3/4	3	E R P	4	100	1	hys syn	belt	belts	10	0.15	0.2	99	45	30-18k 2	30-18k 3	55	1.25	hi	500k	yes	1.0	meters			
															no				e.f.	16	12%	9%	36.5	2	750.00		less case
NORELCO	95	3 3/4	2		2 M	1				5		0.2		180		80-12k			hi	hi	no		eye				
	101	1 1/2	3		2 M	1				4				4					hi	14	10	5	12		80.00	approx.	
														yes						11	3%	8	7		99.50	approx.	
	201	7 1/2 3 3/4	2		4 S M	100	1			7	0.14			120	60-16k 3		40		hi	hi	no		eye				
	401	7 1/2 3 3/4 1 1/2 1 1/2	2		4 S M	100	1				7	0.14			120	50-18k	50-14k	48		hi	hi	yes		meter		built-in ster spkrs	
																		15 1/2	13%	6%	18		149.50		approx.		
150 Carry- Corder	1 1/2	2	E R P	2 M	1	d.c.								100-7k @ 1 1/2"					18	15	10	39		229.50	approx.		
														yes				4 1/2	2%	7%	3		119.50 approx.		batt. oper. cartridge rcdr. 300-ft triple play cartridges - 4 fun.		

TAPE RECORDERS-4



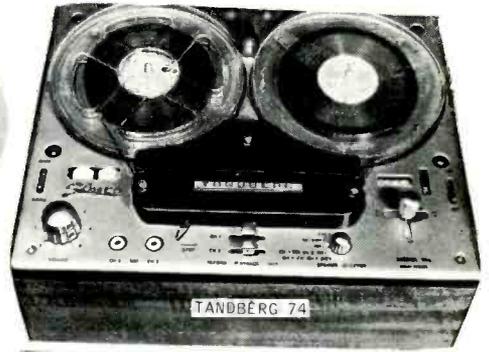
OKI 300D

MANUFACTURER	MODEL NO.	Speeds	No. of heads	Head configuration	Tracks / mode	Playback hd. sp. (in.)	No. of windings	Type of motor(s)	Capstan drive	Rewind & F-ward drive	Max. reel size, in.	Wow & flutter %, 7 1/2	Wow & flutter %, 7 1/2	Tuning accuracy, %	Built-in spt. size, in.	Rewind, 12000, sec.	Swtr. freq. resp. 1/2, ± db	Freq. resp. 7 1/2, ± db	Freq. resp. 3 1/2, ± db	Pwr amp freq resp, ± db	Output Z	Width, in.	S/N, 7 1/2 db	Depth, in.	Mic. input sens, mv	Height, in.	Mic. input Z, ohms	Weight, lbs.	H. L. input Z, ohms	Ampl. output, Type & no. rec. level	Mixing facility	Price	NOTES						
OKI	111	7 1/2 3 3/4	2	E RP	2 M	118					7	0.2			60-13k		50	10k	500k	5	meter												s/s; incl mic						
															3x5		16	11 1/2	12%	14	3w											129.95							
	222	7 1/2 3 3/4	2	E RP	4 M	118					7	0.2			50-15k		50	-70	10k	500k	no	3	meter										s/s; counter; hd output for 2nd chan; Z=800						
															5"			11 1/2	7	12%	16	3w											179.95						
	333	7 1/2 3 3/4	2	E RP	4 S M	118						7	0.2			50-15k		47	-70	10k	500k	3	meters											separable spkrs snd on snd; snd with snd					
ROBERTS	1600		2	E RP	2 M						7																						meter	dig. cntr. mono portable					
	1630	7 1/2 3 3/4 1 1/2	2	E RP	4 S M						7																							meter	portable auto. shutoff dig. cntr				
																																				249.95	= 1630; wal case		
	1630W																																						
720	7 1/2 3 3/4 1 1/2	3			4 S M						7																								meters	prof. type			
770	7 1/2 3 3/4 1 1/2	3									7																								meters	Cross-field			
6000S	7 1/2 3 3/4 1 1/2	3			4 S M						5																									batt. oper. port. incl. battery, charger, mics			
SONY SUPERSCOPE	900	3 3/4 1 1/2	2	E RP	2 M	100	1	d.c.	idler	3	0.25	95			90-9.5k				600		no														none *	* AVC			
	777-4	7 1/2 3 3/4	3	E RP	2 or 4 S, M	100	3	hys (cap)	dir	7	0.1	0.15	99	60	40-15k 2	40-10k 3	50	-70	250 bal	100k	yes	3	meter																
	260	7 1/2 3 3/4	2	E RP	4 S M	100	1	4p	idler	idler	7	0.17	0.2	99	150	50-15k 2	50-12k 3	50	0.1	600	200k	no	3	meter															
250A	7 1/2 3 3/4	2	E RP	4 S M	100	1	4p	idler	idler	7	0.17	0.2	99	150	50-15k 2	50-12k	50	0.1	600	200k	no	3	meter																
500A	7 1/2 3 3/4	2	E RP	4 S M	100	1	hys	idler	idler	7	0.15	0.2	99	150	50-14k 2	50-12k	50	0.5	10k	200k	yes	3	meter																

PRODUCT PREVIEW SECTION - TAPE RECORDERS-5



REVOX G36



TANBERG 74

MANUFACTURER	MODEL NO.	Speeds	No. of heads	Head configuration	Tracks / mode	Playback hd. gap, μ in.	No. of motors	Type of motor(s)	Capstan drive	Rewind & F-ward drive	Max reel size, in.	Wow & flutter, %	Wow & flutter, μ s	Tuning accuracy, %	Built-in speaker	Rewind, 1200', sec.	Spkr. freq. resp., Hz	Freq. resp., 7 1/2" db	Pwr. amp. freq. resp., \pm db	Output Z	Width, in.	Depth, in.	S/N, 7 1/2" db	Mic. input sens., mv	H. L. input Z, ohms	Height, in.	Weight, lbs.	Mixing facility	Amp. outputs, type & db	TID's max. rec. level	Rec. level indicator	Price	NOTES								
REVOX	G36	7 1/2	3	E R P	2 or 4 S M	3	hys syn	dir dir	10	0.1	0.1	99.7	60	40-15k +2,-3	40-12k +2,-3	55	3	0.5M	1M	no	3.0	2 meters	s/d on srd; s/d with snd; 6-w mon. ampl.																		
		3 3/4																																		19	13 1/2	12	45	no	
TANBERG	64	7 1/2	3	E R P	4 S M	120	1	hys belt	belt	7	0.1	0.15	99	100	35-18k 3	40-11k 3	53	1.25	5M	1M	yes	3	eye																		
		3 3/4																																			no	20-25k 2-100k	2-4 16 12	6	33
	74	7 1/2	2	E R P	4 S M	120	4p	belt	belt	7	0.15	0.2	99	100	40-16k 2	40-10k 2	53	1.25	3M	500k	yes	5	eye																		
		3 3/4																																				2	20-25k 2-100k	2-4 16 12	6.5
TELEFUNKEN	Magnetophon 300	7 1/2	3	E R P	2 M	180	d.c.	belt	belts	5	0.2	98	240	40-14k 3		0.15	2k	2M	no	5	meter	s/s; battery operated																			
		3 3/4																																				5	11 1/2	10 1/2	3
	Magnetophon 97 DeLuxe	7 1/2	2	E R P	4 S M	180	1	4p	b3lt	idler	7	0.15	0.2	98	180	30-18k 3	30-16k 3	50	0.15	2M	50k	no	5	eye	2nd spkr built into case lid																
3 3/4	5	16																																					9	11	29
Magnetophon 96 DeLuxe	7 1/2	2	E R P	4 S M	180	4p	belt	idler	7	0.15	0.2	98	180	30-18k 3	30-16k 3	50	0.15	2M	50k	no	5	eye																			
3 3/4	5																																							16	9
UHER	4000-S	7 1/2	2	E R P	2 M	1	d.c. h.f. syn	belt	belt	5	0.15	0.2	99	240	40-20k 3	40-17k 3	56	0.7	2k	47k 1M	no	5	meter	s/s																	
		3 3/4																																						4	100-12k
	6000	7 1/2	2	E R P	2 M	1	syn	idler	belt	7	0.2		98	110	50-16k 3		42	0.2	200	50k 1M	no	5	meter																		
		3 3/4																																							
	7000	7 1/2	2	E R P	4 S M	1	syn	idler	belt	7	0.15	0.2	98	110	50-18k 3	50-15k 3	45	0.15	2k	50k 1M	no	5																			
		3 3/4																																							
8000	7 1/2	4	E R P	4 S M	1	syn	idler	belt	7	0.15	0.2	98	110	50-20k 3	50-16k 3	50	0.15	2k	50k 1M	yes	5	meter																			
	3 3/4																																								3x5
9000	7 1/2	3	E R P	4 S M	1	hys syn	idler	belt	7	.08	0.11	99.5	110	20-20k 2	20-15k 2	60	0.15	5k	47k 1M	no	0.15	meters	wal case plastic cover																		
	3 3/4																																								
VIKING OF MINNEAPOLIS	88	7 1/2	3	E R	4 S	2	4p	belt	belt	7	0.2	99.5	90	30-18k 3	32-12k 3	55	1			no		meter	also available as 2-tr model																		
		3 3/4																																							none

PRODUCT PREVIEW SECTION - TAPE RECORDERS-6



SONY 777



WOLLENSAK 1980

MANUFACTURER	MODEL NO.	Speeds	No. of heads	Head configuration	Tracks / mode	Playback hd. sp. / in.	No. of motors	Type of motor (S)	Capstan drive	Rewind & F-wind drive	Max reel size, in.	Wow & flutter %, 7 1/2	Wow & flutter %, 3 1/2	Tuning accuracy %	Built-in spk size, in.	Rewind, 1/2000, sec.	Spkr. freq. resp. / ± db	Freq. resp. / ± db	Pwr amp freq resp / ± db	Output Z	Width, in.	Depth, in.	Height, in.	Weight, lbs.	Amp. outputs	Mixing facility	Price	NOTES
VIKING (Cont'd)	220 Retro-Matic	7 1/2 3 3/4	4	E R P P	4 S M	3	2-4 hys	belt	belt	7	0.2			99.5	45	20-25k 3	20-15k 3	55	1					yes	meter		860.00	automatic reverse
	STUDIO 96 Transport	2 *	up to 4	any	any	3	2-6 hys	belt	belt	10	0.2			99.5	35											585.00 and up	transport only, no electronics; speeds-7 & 3 3/4; 15 & 7 ; 3 3/4 & 1 7/8	
	230 Transport	2 *	up to 5	any	any	3	4p or opt	belt	belt	7	0.2			99.5	45					16 or 19	8	10 1/2	22		322.00 and up	transport only, no electronics; speeds-15 & 7 ; 7 & 3 3/4; 3 3/4 & 1 7/8		
WOLLENSAK	1288	7 1/2 3 3/4	1	RPE	4 S M	100	1	4p	belt	idler	7	0.3			135	50-17k 3	50-8k 3	48	2	10k	470k	no	3	2 meters		259.95	sep. spkrs, 10" x 18" x 5"	
	1980	7 1/2 3 3/4	1	RPE	4 S M	100	1	4p	belt	idler	7	0.3			135	40-18k 3	40-13k 3	48	2	10M	470k	no	3	2 meters		339.95	snd with snd	
	5150	7 1/2 3 3/4 1 7/8 1 1/2 1 5/8	1	RPE	2 M	100	1	cap run	idler	idler	7	0.25	0.3		70	40-17k 3	50-10k 3	48	2	10k	33k	no	3	1 meter		149.95	all these models have same specs except as ind; all are new 1965 models	
	5200 (deck)				4 S M										no											2 meters	179.95	
	5250														2 4x6											2 meters	189.95	
	5280														2-6											2 meters	219.95	
	5300														sep											2 meters	279.95	
	7000 (deck)	1 3/8	2	E R P	2 S M										60 *	40-15k @ 1 1/2 3				2	10M	1 M			2 neon		339.95	stereo tape cartridge, 3 1/4 sq. all these models have same specs except as ind. all are new 1965 models.
	7100														2 4x8						8						399.95	*cartridge change cycle
	7200														sep						16	8 1/2	15 1/2	4 3/4			459.95	

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Rear view of Lancer 99 showing Stereo Energizer.

Model SE401 80 Watt Solid State Stereo Energizer

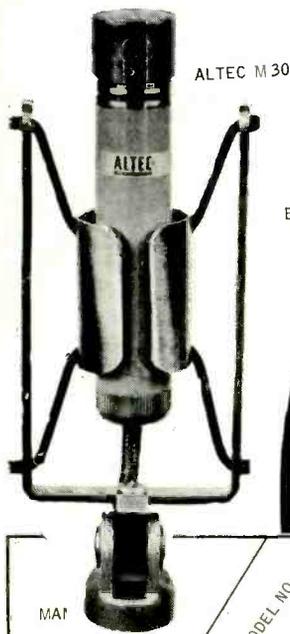
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Circle 134 on Reader Service Card

PRODUCT PREVIEW SECTION — MICROPHONES-1



ELECTRO-VOICE
635A



AMPEX 2001



NEUMANN U-67



MANUFACTURER	MODEL NO.	Type	Directional pattern	Pattern adjustable	Diaphragm material	Case material	External finish	Impedance, ohms	Freq. resp. ± db	EIA sensitivity	Mic. connection	Cable length, ft	Cable plug type	Dimensions	Weight, oz.	Mounting method	Price	NOTES
ALTEC-LANSING	686A	dyn	omni	no	metal	baked enam	30/50 150/200	70-20k			20		1 1/2 d x 3/2 l	3	neck cord	45.00	lavalier	
	M30	cond	card	no	Mylar	metal	30-10k or more	20-20k			30		1 1/8 d x 2 7/32 l	2	stand	280.00	sep. pwr. supply	
AMPEX	701	dyn	omni	no	Mylar	di cst alum	ptd high	70-10k		perm affxd	6	phone plug	3/4 d x 3 1/2 l	6	hand/stand	9.95	with stand and lavalier	
	2001	dyn	omni	no	mylar	alum & plas	tex'd br. stn	high	50-15k		6	"	1 1/2 d x 7 l	8	"	34.95	with stand	
DYNACO	B&O 50	ribn	fig 8	no	durol	brass	br. chr.	50	30-13k 2.5	spec	20	none	1 1/4 d x 7 3/4 l	15	1/2-27	59.95		
	B&O 53	"	"	"	"	"	"	100	"	"	"	"	"	"	"	69.95		
	B&O 100	"	"	"	"	"	"	200	"	DIN	"	"	"	"	"	89.95		
	B&O 200	"	"	"	"	"	"	"	"	"	"	"	1 1/4 d x 10 1/4 l	"	"	149.95	stereo microphone	
ELECTRO-VOICE	635A	dyn	omni	no	acous alloy	metal	br. chr.	150	60-15k 2	149	Cannon	18	none	1 1/2 d x 5 1/4 l	6	1/4-27 adap	49.20	built-in pop filter and windscreen; shockprf.
	676	dyn	card	no	"	"	gr or gold	150 hi	40-15k 3	151 lo 152 hi	Amph	16	none	8 3/4 x 1 1/4 d	12	"	60.00	slim cardioid; 3-pos bass tilt integral switch
	664	dyn	card	no	"	"	"	150 hi	40-15k 3	149 lo 151 hi	"	"	"	1 7/8 d x 7 1/4 l	26	"	51.00	for exacting PA and recording applications
	619	dyn	omni	no	"	"	TV gr	150 hi	70-10k 3	151	none	16	none	9 1/4 h x 4 1/2 l	36	desk stand	28.50	push or grip to talk switch with locking feature
	667A	dyn	card	no	"	"	gray	50 150 250	40-10k	150 145 149	Cannon	20	none	6 1/2 d x 9 1/4 l	24	boom or stand	207.00	professional cardioid; 6 variations of response
GELOSO	M52	dyn	omni	no	"	metal	br. chr.	250	60-20k 3		spec	10	none	1" d x 3 7/8 l	6	1/2" pipe	55.50	cartridge type; anti-hiss shield
	M53	"	"	"	"	"	"	45k	"	"	"	"	"	"	"	55.50	same as M52 exc. hi-Z	
	M18	dyn	"	"	"	"	"	250	"	none	"	"	1" d x 3 3/4 l	6	collar or conv	18.95	removable cord and holder lavalier type	
	M19	"	"	"	"	"	"	45k	"	"	"	"	"	"	"		same as M18 exc. hi-Z	
	M22	dyn	omni	no	"	"	"	250	"	"	"	"	"	"	1/2" pipe	29.95	cartridge type	
NEUMANN	U-64	cond	card	no	Mylar	metal	satlt chr.	30/50 150/250	40-18k	137	Cannon	25	Cannon	3/4 d x 4 3/4 l	3.5	1/4-27 swvl	360.00	miniature type; switchable 10-db ovid protection
	U-67	cond	card	omni fig 8	Mylar	"	"	"	40-1.6k	142	suppld	"	"	2 1/4 d x 7 1/4 l	16	"	460.00	switchable ovid protection; prox. corr. sw; ideal for close miking
	M-49C	cond	card	cont om-8	Mylar	"	"	"	30-1.5k	139	suppld	"	"	3" d x 6 1/2 l	29	"	495.00	var. pattern remotely controll internally shock mounted
	KM-56C	cond	card	omni fig 8	Mylar	"	"	"	"	"	suppld	"	"	7/8" d x 6" l	5	"	460.00	miniature type; M-S ster. susp. accy available.

PRODUCT PREVIEW SECTION - MICROPHONES-2

RESLO RBT/H



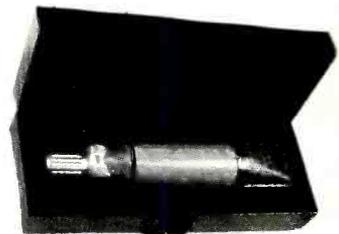
SHURE 545



SENNHEISER MKH 404/405



PML EC-61



SYNCHRON AU-7a

MANUFACTURER	MODEL NO.	T. type	Directional pattern	Pattern adj. to	Diaphragm material	Case material	External finish	Impedance, ohms	Freq. resp. \pm db	EIA sensitivity	Mic. connection	Cable length, ft	Cable plug type	Dimensions	Weight, oz.	Mounting method	Price	NOTES
NORELCO	D-119ES	dyn	card	no	Mylar	metal	br. chr.	200	40-16k 3	147	Cannon	15	Cannon	7 $\frac{1}{4}$ x 1 $\frac{1}{8}$	7	$\frac{3}{8}$ -27	69.00	
	D-12	dyn	card	no	Mylar	"	"	"	"	148	"	15	none	5 $\frac{1}{2}$ x 2 $\frac{1}{2}$ x 2 $\frac{1}{8}$	17	"	99.00	
	C-12A	cond	card omni fig 8	yes	Mylar	"	"	"	20-20k 2	136	Cannon	66	Cannon	"	"	"	480.00	
	DX-11	dyn	card	no	Mylar	plas	"	200 hi	50-15k 3.5	146 130	"	15	none	"	"	"	130.00	built-in reverb., controllable
PML	KK-61	cond	omni	no	Mylar	metal	satn chr.	120 hi	30-18k 3	-70	none	10	none	1 $\frac{1}{2}$ d x 2 $\frac{1}{8}$	1.25	$\frac{3}{8}$ -27	99.50	requires pwr supply; lo-Z are balanced; hi-Z unbal.
	EC-61	cond	card	no	"	"	"	"	"	"	"	"	"	"	"	"	99.50	same as KK-61 exc. pattern
	D44HL	dyn	card	no	PVC	"	blk anod	200 hi	60-16k 2.5	-71	"	13	"	$\frac{3}{8}$ d x x 5	5	"	34.95	built-in wind scr; Z varied by cable change
	RD 36	dyn	card	no	"	"	sat chr & blk	"	30-20k 5	-74	"	18	"	1 $\frac{1}{4}$ x 4 $\frac{1}{8}$	5.1	"	89.50	fur. with flex. gooseneck Z chgd by cable
	TC6	cond	card	no	Mylar	"	blk & silver anod.	200	30-20k 2.5	-60	"	"	"	1 d x 7 $\frac{3}{4}$	14.3	"	295.00	Built-in s/s pwr supply rechargeable
RESLO	CR2	ribn	card	*	durol	metal	sat chr & gray enam	30/50 hi	60-16k +4, -5	150	spec	18	none	1.5 x 2 $\frac{1}{4}$ x 4.5	9	$\frac{3}{8}$ -27	50.00	also avail other finishes *all are adjustable by means of damping for close talking or high-quality speech work, with some cardioid effect new models; not same as Celeste, Symphony, etc.
	RBT/H	"	fig 8	*	"	"	satn chr	"	30-16k 3	148	"	"	"	1.5 x 1.5 x 2	"	"	50.00	
	VRT	"	"	*	"	"	"	300	40-16k 2	155	"	"	"	"	9	"	75.00	
	SR1	"	"	*	"	"	flor brnze	250/ 300	30-20k 2	147	"	"	"	1.5 x 1.5 x 6	11	"	112.50	
	PR/H	"	"	*	"	"	satn chr	30/50 hi	50-15k 5	150	"	"	"	"	"	"	43.50	
SENNHEISER	MD407	dyn	card	no	plas	plas & metal	dk gry & chr	200 hi	100-12k	-56	none orph	5	ph plg	3x2 x1.5	9	*	32.00	*self standing & thread for home tape recorders
	MD403	dyn	card	no	"	metal	brsh chr	200 80k	80-12k 3	-56	none orph	5	ph plg	3.5 x 2.2 x 1.5	11	*	41.50	
	MD21	dyn	omni	no	plas	metal	chr & lacq	200	50-15k	-53	Tuchel	5	none	4.7 x 1.8 x 1.8	9.2	*	57.00	*thread or gooseneck for TV news recording
SHARPE	FM-2T								20-20k								34.50	cordless FM transmitter s/s
	HAM-301	dyn							60-15k		spec						21.00	40 db noise cancellation at 1 kc.
SHURE	545	dyn	card	no	Dura- *	metal	chr & blk	150 hi	50-15k	149 151	Amph MC4	18	none	1 $\frac{1}{4}$ d x 5 $\frac{1}{8}$ d	9.6	$\frac{3}{8}$ -27 **	51.00	* Shure "Duracoustic" ** swivel adapter incl. *
	55SW	dyn	ultra card	no	spec alloy	di cst Zn	satn chr	120 hi	50-15k	149 153	Amph MC3	18	none	7 $\frac{3}{8}$ x 2 $\frac{1}{8}$ x 3 $\frac{1}{8}$	26	$\frac{3}{8}$ -27	51.00	has 3-way Z sw + on/off sw. mod. 555 w/o sws.
	578S	dyn	omni	no	Dura- *	steel	satn chr	50/250 hi	50-15k	151 155	Cann	18	none	$\frac{3}{4}$ d x 9 $\frac{1}{8}$	13	"	54.00	permanent swivel mount with on/off sw
	550S	dyn	omni	no	Dura- *	metal	satn chr	"	50-15k	149 154	Amph MC3	18	none	1 $\frac{1}{2}$ d x 4 $\frac{1}{8}$ d x 6 $\frac{1}{8}$	15	"	41.40	"
	580SA 580SB	dyn	card	no	Dura- *	di cst	" & blk	hi lo	50-11k "	155 152	att. cable	15	none	1 $\frac{1}{2}$ d x 6 $\frac{1}{8}$	22	"	35.40 31.20	on/off sw built in 580SA matched for stereo, \$70.80/pr

PRODUCT PREVIEW SECTION — MICROPHONES-3

MANUFACTURER	MODEL NO.	Type		Directional pattern	Pattern adj.	Diaphragm material	Case material	External finish	Impedance, ohms	Freq. resp. ± dB	Sensitivity	EIA sensitivity	Mtc. connection	Cable length, ft	Cable plug type	Dimensions	Weight, oz.	Mounting method	Price	NOTES
		cer	dyn																	
SONOTONE	CM-10A	cer	omni	no		alum	metal	br. chr.	2M	50-12k	156		7	phone plug	1 $\frac{1}{16}$ " d x 5 $\frac{1}{4}$ " l	7 $\frac{1}{2}$ "	hand held		18.40	desk-stand, lavalier
	CM-1050 WR	cer	omni	no		"	"	"	M	50-10k	163		7	"	"	7 $\frac{1}{2}$ "	"		19.45	
	CM-30	cer	omni	no		"	plas	gray	1M	60-7k	160		6 coil cord	none	2 $\frac{1}{4}$ " x 3 $\frac{1}{8}$ "	6"	"		14.70	spot pushbutton sw. hang-tip button
	DM-10	dyn	omni	no		Mylar	metal	br. chr.	10k	60-16k	153		7	phone plug	1 $\frac{1}{16}$ " d x 5 $\frac{1}{4}$ " l	8"	"		24.50	desk-stand lavalier; 600 & 50k ohms avail.
	DM-70	dyn	omni	no		Mylar	metal	br. chr.	10k	60-15k	153		7	"	1 $\frac{1}{16}$ " d x 4 $\frac{1}{2}$ " l	5"	"		32.50	desk-stand lavalier; 200, 600, & 50k avail.
SONY	C-37A	cond	omni uni	yes		poly	metal	br. chr. satin gr	50 250	20-18k 2	-52	spec	2	spec	1 $\frac{1}{2}$ " d x 5 $\frac{1}{16}$ " l	16"	1/8"-27		295.00	with carrying case & power supply
	CR-5	cond	omni	no		metal	metal	flat blk	hi	80-10k 2	1 v. out	spec	18	—	3/4" x 2 1/2"	19.2"	none		375.00	wireless mike; price incl. 8-tube FM rec. & carry case
	F-91	dyn	omni	no		poly	alum	br. chr. & fl blk	*	40-18k 3	150	spec	18	none	1 $\frac{1}{16}$ " d x 1 $\frac{1}{4}$ " l	5"	1/8"-27		149.50	* available 150, 250, or 10k ohms out, sw. selected
SYNCRON	AU-7a	cond	card	no		Mylar	alum	beige nickel	50 200	40-20k 3	142	spec	20	none	1 $\frac{1}{8}$ " d x 9/32"	23"	1/8"-27		169.50	transistorized, self-cont. battery powered
LTV UNIVERSITY	ATTACHE	dyn	card	no		unilar	alum	fl blk anod	150	50-15k	151	built-in	15	none	1 $\frac{1}{16}$ " d x 3 $\frac{1}{16}$ " l	8"	lav.		39.95	
	8000	dyn	card	no		"	zamac 3	br. chr.	250 hi	70-15k	151	Cann	15	none	1 $\frac{3}{32}$ " d x 6 $\frac{3}{16}$ " l	16"	"		29.95	supp. with stand adapter for 1/2" pipe, shock mtd.
	8100	dyn	card	no		"	"	"	"	"	154	"	15	"	"	17"	"		31.50	
	2000	dyn	omni	no		"	"	"	"	50-14k	143	built-in	15	"	1 $\frac{1}{32}$ " d x 6"	26"	"		23.10	
	1000	dyn	card	no		"	"	"	l, m, h	30-16k	147	"	18	"	1 $\frac{3}{4}$ " d x 8 $\frac{1}{16}$ " l	38"	"		81.00	
VEGA	Vega 20	cond	omni	no		Mylar	alum	blk vinyl & alum	l, m, h	20-20k 2.5	157	none	20	Cann	7/8" x 5"	6"	std swvl		185.00	reqs. sep. pwr supply stereo - 2 mics & dual p.s.
	Vega 22	cond	omni	no		Mylar	alum	blk vinyl & alum	l, m, h	20-20k 2.5	157	none	20	Cann	7/8" x 5"	6"	std swvl		315.00	reqs. sep. pwr supply stereo - 2 mics & dual p.s.
	Vega-Mike	dyn	omni	no		Mylar	alum	dk. gry enamel	hi or lo	80-14k	140	wireless	none	*	1" d x 5"	7 $\frac{1}{2}$ "	lav *		546.90	price incl. Vega FM recvr; operates in 25-45 mc band. * or hand held.

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PRODUCT PREVIEW SECTION — **HEADPHONES**



KNIGHT KN-875



LAFAYETTE 767



KOSS PRO-4



PML D-42



SHARPE HA-10



SUPEREX ST-PRO



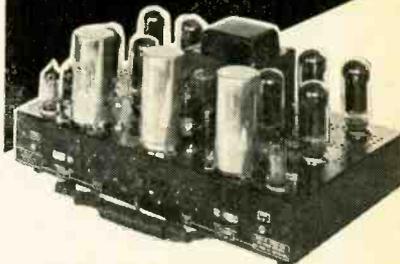
TELEX ST-10

MANUFACTURER	MODEL NO.	Type	Freq. resp.		Input impedance	To work across source ohms	Sensitivity, mw.	Max. output, dbm	Max. power input	Distortion, %	Plug type	Cord length, ft.	Weight, oz.	Price	NOTES
			F	B											
AMPEX	470	dyn	40-15k	8	8	—	—	—	—	3-cct plug	24	27.95		foam ear pads	
	471	dyn	40-15k	8	8					"	24	37.95		incl. ster. bal. cont. at headset	
KNIGHT	KN-875	ster	20-16k	4/16	4,8,16	110	120	5w	2.5	3-cct plug	8	16	14.95	foam	
	KN-876	ster	16-16k	3/16	4,8,16	105	120	2w	2	"	8	13	19.95	poly-foam	
KOSS	PRO-4	dyn	30-20k	50	4,8,16		120	1w	1	3-cct plug	8	19	45.00	fluid-filled cushions	
	SP-3X	dyn	10-15k	4	4,8,16		143	10	1	"	8	15	24.95	extremely sensitive	
	SP-5NS	dyn	10-15k	5.3	4,8,16		143	10	1	"	8	12	24.95		
	SP-5SM	dyn	10-15k	5.3	4,8,16		143	10	1	"	8	12	24.95	for use w/ elec organ	
	SP-5VW	dyn	10-15k	5.3	4,8,16		143	10	1	2-"	8	12	24.95	no common ground	
LAFAYETTE	767	dyn	30-15k	8	4,8,16	2 mv				3-cct plug	6	11 1/4	11.88	foam ear pads; incl over'l'd jctn box	
NORELCO	K-50	dyn	20-20k	75/400	4,8,16		127		1				22.50		
PML	D-42	dyn	30-20k	200	8,15	300		0.25 v.	2	none	6	6.3	24.95	det. ear pads; can be washed for sanitizing	
PIONEER	SE-2P	dyn	25-10k	6	4-16	500				3-cct plug	6	16		foam ear pads	
	SE-2P 2-way	dyn	30-18k	6	4-16	125				"	6	16		air-cushioned ear pads	
SHARPE	HA-8	dyn	20-15k	8	8		120	2	2	3-cct plug	6	14	24.50	foam ear pads	
	HA-10	dyn	30-15k	3	8		138	2	2	"	6	22	43.50	liquid seals	
	CM-4	dyn	20-20k	8	8		110	2	3	"	6	14	14.50	molded soft vinyl ear pads	
SUPEREX	ST-PRO	dyn cer	40-22k	16	4,8,16	30	125	2		3-cct plug	7	15	50.00	soft vinyl-foam pads 2-way; tweeter is cer	
	ST-M	dyn cer	40-18k	16	4,8,16	20	125	2		"	7	15	29.95	" "	
	ST-S	dyn	40-15k	16	4,8,16	20	125	2		"	7	14	24.95	soft vinyl-foam pads	
	SX-800	dyn	40-15k	16	4,8,16	15	110	0.5		"	7	5	21.95	" "	
	SX-700	dyn	40-15k	16	4,8,16	15	110	0.5		"	7	6	22.95	" "	
TELEX	ST-10	dyn	16-15k	12	3.2-16	1*	124	2	3	3-cct plug	8	12	24.95	* for 95 db SPL soft ear pads	
	ST-20	dyn	16-15k	12	3.2-16	"	125	2	3	"	8	12	29.15	integral vol. cont. on each ear cup	
	HDP-53A	dyn	30-15k	10	3.2-16	"	120	1	3	"	8	12	24.95		

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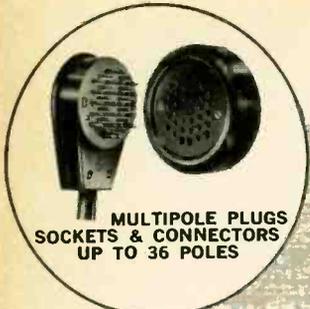
For further details, write:

Dealer inquiries invited

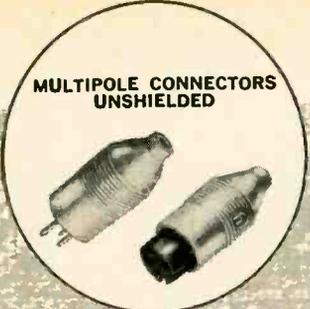


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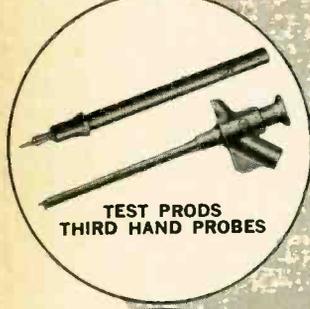
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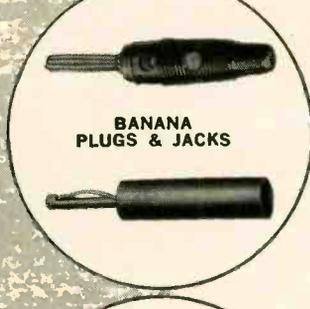
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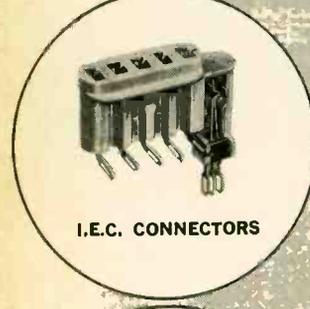
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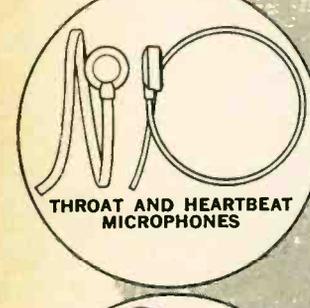
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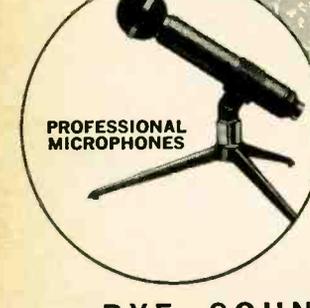
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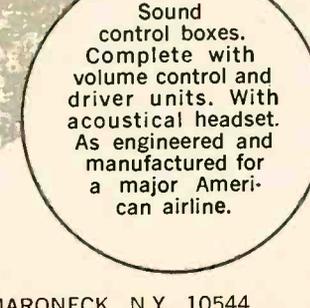
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MISCELLANEOUS-1

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900 Series: ranges from 150' 1.5-mil reel at 65c to 2400' 0.5-mil reel at \$7.95, in both Mylar and acetate bases. Other lengths are: 225', 300', 600', 900', 1200', and 2400'.

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AUDIO DEVICES

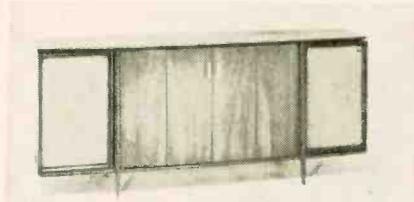
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This new "low-noise" Audiotape is unique in that it not only provides excellent low-noise characteristics, but also does not sacrifice those characteristics necessary for critical professional recording.

Prices — on application from dealers and distributors.



AUDIO ORIGINALS

Component Cabinetry

Large selection of shelf-type and floor-standing equipment and speaker cabinets in many popular styles and finishes. Prices range from \$79.50 to \$329.95

ELECTRO-VOICE

XT-1 Stereo Mixer Transformer

Combines stereo channels to mono for center channel or remote mono loudspeaker. Price — \$16.50.

KD6A Aristocrat Enclosure Kit. Walnut exterior, folded-horn kit, for 12" in speakers and "building-block" mid- and high frequency speaker combinations. Size — 29 $\frac{1}{2}$ " high x 19" wide x 15 $\frac{7}{8}$ " deep. Price — \$60.00.

KD10 Equipment Enclosure Kit. 29 $\frac{1}{2}$ " high x 21" wide x 18 $\frac{1}{4}$ " deep, with adjustable shelf for electronics; lift top and front-opening doors. Price — \$75.00

BB1 VHF Building Block Kit. Includes T35 tweeter, X36 crossover network, wiring harness, and AT37 level control. For use with high-quality 16-ohm woofers. Price — \$44.00.

BB4 Midrange Building Block Kit. Includes T25A driver, X8 crossover network, wiring harness, and AT37 level control. Price — \$108.00.



BARZILAY

Component Cabinet Kit, Model 1B

Consists of 1 equipment cabinet kit and two speaker enclosure kits in oil-stained walnut finish. Assemble in 4-6 hours, using only Phillips-type screwdriver. Prices: \$299.00 complete. Equipment cabinet only, \$179.00; Speaker pair, \$120.00. Other kit and assembled designs available.

CBS LABS

Test Record — Seven Steps to

Better Listening. Includes L-R identification, speaker phasing and balance, tone-control setting, buzz and rattle identification, and tracking study. Requires no instruments or technical knowledge. Detailed operating booklet by E. T. Canby is included. Price — \$5.00.

THE FINNEY COMPANY

FM Antennas

FINCO Model FM-4G Broadband (88-108 mc) Twin driven, wide-spaced, 6-element, 300-ohm antenna with very high front to back ratio. Up to 9.6 db gain across FM band. Pre-assembled with snap-out self-aligning sleeved elements. 7'9" square boom, 55 $\frac{1}{2}$ " turning radius. Gold Corrodized. Price — \$24.90.

FINCO Model FM-5 Broadband. Similar to above, but with 10 elements and 11.6 db gain. 10' square supported boom, and 70" turning radius. Price — \$36.35.

FINCO Model FM5L "Stereo Log Broadband," 10 elements, with 5-element multiple drive. 4 directors, 1 reflector, narrow pattern. Up to 11.0 db gain. Same size as FM-5. Price — \$39.95.

FINCO Model FM5L-12. As above, but with 12 elements; 6 directors, 1 reflector; up to 12 db gain. Effective in eliminating interference to FM reception caused by TV, radio amateurs, CB, auto ignition, fluorescent lights, etc. Price — \$6.95.

FM Band-Pass Filter, FINCO Model 3007. Passes only FM band frequencies with less than 1 db loss. Effective in eliminating interference to FM reception caused by TV, radio amateurs, CB, auto ignition, fluorescent lights, etc. Price — \$6.95.

FISHER

K-10 Spaceexpander (Reverberator)

May be used with mono and stereo preamps and power amps, integrated amplifiers, receivers, and tape recorders to create controlled reverberation. Delay time, 33 milliseconds; decay time, 2 secs @300 cps. Input voltage range, 0.2 to 5 volts. Input Z, 250-k ohms; output Z, 2000 ohms. Unity gain. Hum level, 80 db below 2.5 volts. Price — \$79.50

GELOSO

Microphone Accessories

Flexible goose-neck microphone supports, noiseless. Models F6, 9 $\frac{1}{2}$ " long, \$11.95; F8, 14 $\frac{1}{2}$ " long, \$12.45; F7, 12" long, with on/off switch, \$17.95; F9, 17" long, with on/off switch, \$18.45.

Dual Mike Holder, for either directional or non-directional microphones or both, Model SD87, \$12.75.

Mike Mixer, for 4 microphone inputs, in portable case, for either 110 or 240 v. Model G300V, \$131.95.

Floor Stand. All steel, 3-legged triangular base, brushed chrome finish, friction grip; extends to 5'. Model B92, \$19.95.

Desk Stands. As above, extends to 2'. Model B82, \$17.95. Model B80/CR, 3" high, chrome stand with rubber edge, \$4.45.

GREENTREE ELECTRONICS

"AMERICAN" Tape

Standard Series, Acetate base, 1 $\frac{1}{2}$ and 1 mil, lengths of 150 to 7200 ft., 60c to \$24.50. Mylar base, 1 $\frac{1}{2}$, 1, and $\frac{1}{2}$ mil, lengths of 300 to 7200 ft., \$1.25 to \$18.75.

Professional Length Series, Acetate and Mylar; lengths of 600 to 3600 ft. Only complete line of long-playing tapes.

Low-Noise Slow-Speed Series, Acetate and Mylar bases, full line in lengths from 600 to 2400 ft.

Pinnacle of SOUND imagery!

From the traditional house of sound comes the fabulous HERITAGE SERIES of sound systems. UTAH has a tradition of producing the finest quality speakers and cabinets and this new series is part of that heritage. Both bookshelf and console models set new standards in total quality. Each high styled cabinet is individually assembled. Tweeters have a "double shell" construction with fiberglass between the chassis and outside cover to minimize reflections. High flux density and a special cone clamping technique contribute toward the high efficiency. Woofers have massive Alnico V magnetic circuits and large diameter voice coils for effortless reproduction. Utah's crossover networks are tailored to the reproducers and enclosures for best system "balance" and minimum distortion.



Heritage I
Bookshelf Model
3-speaker system
12" woofer
2-5" tweeters



Heritage II
For the expert
connoisseur
4-speaker system
Frequency response:
25/20,000 cps
Power handling:
50 watts



Heritage III
A new level of
music enjoyment
8-speaker system
Frequency response:
20/20,000 cps
Power handling:
80 watts

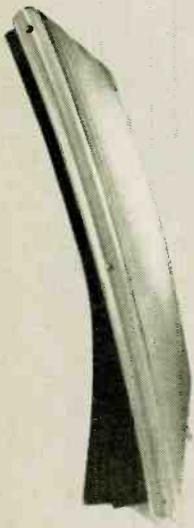
Write or call for complete information



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Utah's HERITAGE Hi-Fi/Stereo Sound Systems

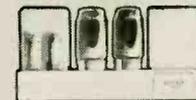
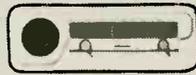
choosing hi-fi equipment?



Amid superlatives, the gimmicks, specifications and the gadgets, don't lose sight of the object of it all . . . for the closest approach to the original sound

QUAD

Write direct to
Acoustical Manufacturing
Company Ltd.,
Huntingdon, Hunts,
England.
or ask your own Hi-Fi
dealer for full details



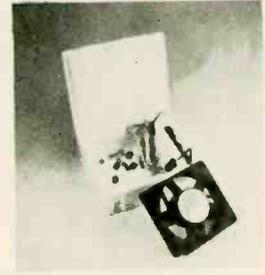
PRODUCT PREVIEW SECTION —

MISCELLANEOUS-2

HARTLEY

Crossover Network

Two-stage crossover network, for woofer and midrange tweeter, f_c is 350 cps, with 12-db drop; employs 2 capacitors and 2 inductances. Model 350, Price \$40.00.



IMC MAGNETICS

Fan

Fits any cabinet and minimizes thermal drift and adds to life of equipment by improving component life. Rugged metal housing acts as efficient heat sink, adds to motor and bearing life. 115-volts a.c., 0.1 amps. Exhausts air 10 to 20 times per minute from average enclosure. Supplied with mounting kit and instructions for universal mounting system. Price — \$14.85.

INTERNATIONAL ELECTRONICS CORP. Mullard Tubes

Supplied in matched pairs to ensure proper balance in the output stages of power amplifiers and thus enhancing reproduction quality in your home system, these Mullard Tubes are ideal replacements. Matched pairs are available in all popular types, ranging in price from \$5.00 per pair for EL90's to \$23.90 for KT88's. Order from your dealer, using the suffix "MP" to the tube type to indicate matched pair.

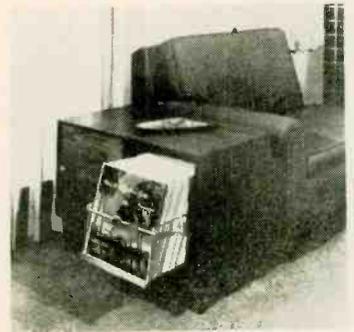
JFD ELECTRONICS FM Antennas and Accessory Equipment

Model LPL-FM10 Log Periodic FM Antenna. Ten elements, including 5 driven cells and 5 co-linear directors provide gain up to 41% better than the best 10-element Yagi. Narrow beam width of 37.5° and front-to-back ratio of 26 db, coupled with a VSWR of 1.5:1, gives superior performance. Gold-rodized protective finish. Impedance, 300 ohms. Price — \$49.95 list.

Model FT-1 FM Signal Booster, Outdoor type. Separate ruggedized amplifier may be mounted on antenna boom or mast; powered by low voltage through lead-in wire from indoor power supply. Provides output for two FM tuners at gain of 16 db and noise figure of 5.3 db. Maximum input signal, 45,000 microvolts; maximum output signal, 292,500 microvolts. Price — \$34.95 list.

Model EF-1 FM Signal Booster, Indoor type. Transistor amplifier with output for 1 300-ohm tuner, provides extra signal required for stereo multiplex reception. Price — \$17.95 list.

All-Directional FM "S" Antennas. Three models: AFM400, with roof mount kit, \$11.95 list; AFM450, with add-on kit for existing TV antennas, \$6.95 list; AFM475, same as AFM450 plus 50 ft 300-ohm lead-in and standoffs. Price — \$8.95 list.

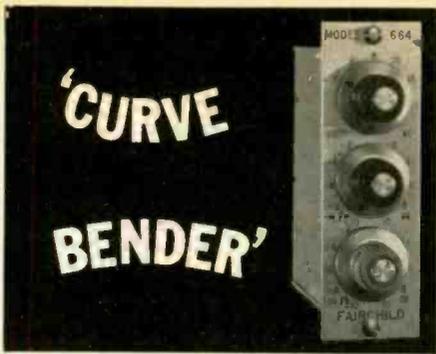


KERSTING

"Quick-See" Record and Tape Storage

Model A-100 "Quick-See" File provides for 100 12¹/₂-in. LP albums. \$13.95. Other models hold from 50 to 125 albums — prices range from \$7.95 to \$16.95.

Model E-1 Record Storage Cabinet. 22¹/₄" high, 32" wide, and 16" deep, \$54.95. Other models available.



That's what our British friends call an equalizer and, we too, think it is a very appropriate name. Today's recording demands continually specify curve bending for almost every channel. And, the 1½" narrow FAIRCHILD Curve Bender (equalizer) offers complete flexibility. Unit includes five equalization points at 4, 6, 8, 10 and 15 kc with a maximum boost or rolloff of 10 db in 5 steps. The FAIRCHILD Curve Bender also has low end equalization using a maximum of 10 db boost or rolloff in 5 steps. Easy to install . . . passive. The FAIRCHILD Equalizer can be the difference between a hit or miss in recording sessions.

An Integra/Series Component—Model 664
Price: \$145.00
 For complete details write

FAIRCHILD
 RECORDING EQUIPMENT CORPORATION
 10-40 45th Ave., Long Island City 1, N.Y.

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 Send a check**

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PRODUCT PREVIEW SECTION —

MISCELLANEOUS-3



KINEMATIX, INC. Wireless Microphone; Accessories.

Imp II Wireless Microphone, Model KX-221. Ideal for churches and paging systems. Frequency range, 88-108 mc; tunable; no license required. Response from 20-20k cps. Price — \$39.95.

Model VX-400 Verbanatix Car Reverb. Easy installation and operation. Has reverb control and fader. No drilling to install; includes 7-oz. ceramic speaker with grille. Price — \$49.95.

Model KX-4000 Voice-Matic voice-operated relay. Capable of controlling devices or appliances by voice command. Optional delay feature available. Excellent for voice-operated tape recorder. Price — \$24.95.

McINTOSH Multipath Indicator

CR tube displays signal strength, center channel, stereo separation, phase, and multipath interference. Vert. sensitivity, 0.37 v/in.; hor. sensitivity, 0.27 v/in. 159/8" wide, 5 1/2" high, 1 1/2" deep. Employs 3RP-1 CRT. Easily connected to McIntosh tuners and receivers and others.

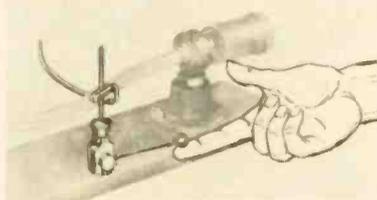


MULTICORE 5-core solder

Available in numerous types of alloys and in all gauges, and in various packaging, ranging from the Easy Dispenser at 69¢ through 1-lb. packs and 7-lb. reels for large users. (This reel should last the average hi fi hobbyist for five years.) Savit alloy contains copper, protects soldering iron tip.

NETWORK Spark Injector

Not a typical hi fi product, but gives high fidelity performance to your automobile. A transistorized ignition system which provides increased spark energy at high speeds for greater efficiency and power, 110% increase in spark energy at 4000 r.p.m., 75,000-mile point life, increased gas intake. Price — \$49.95 for cars with negative ground. Also available for positive ground as used in most European sports cars, \$59.95.



ORTOFON "Hi-Jack" Record Cueing Device

Permits raising and lowering the arm on a manual turntable pneumatically without touching the arm itself. Saves records and stylus, and facilitates accurate cueing. Price — \$10.00.

REEVES SOUNDCRAFT Tape Accessories

Colored Leader and Timing Tape. 1/4 in. x 150 ft., in various colors. Price — \$1.10.

Tape Indexing Flaps. Apply onto tape to locate selections instantly; various colors; 1 1/2-mil Mylar. Price, pkg., — \$1.00.

Triple-Play Recording Tape. New magnetic oxide provides excellent frequency response. 1/2-mil by 2400 ft. on 5 3/4-in. reel. Price — \$6.96.

Only OKI

has a complete lightweight solid-state portable stereo tape system under 25 lbs.



Only OKI

has 2 unique detachable two-way speaker systems for true stereo sound.



Only OKI 555 plays so great, weighs so little!

Guaranteed for one full year!

And its price is less than you'd expect to pay. \$349.95*.

Oki has a fine choice of other solid state tape recorders, starting at \$129.95*. See and hear them now at your Oki dealer.

*manufacturer's suggested list price
 (one year parts, 6 months labor)

OKI CHANCELLER

A 463

Chancellor Electronics, Inc.
 457 Chancellor Ave., Newark, New Jersey

Name _____
 Address _____
 City _____ State _____ Zip _____

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FROM ANY ANGLE
 IF YOU'RE LOOKING FOR
 PERFORMANCE, ECONOMY, LUXURY,
 DEPENDABILITY AND TRUE
 DOLLAR FOR DOLLAR VALUE

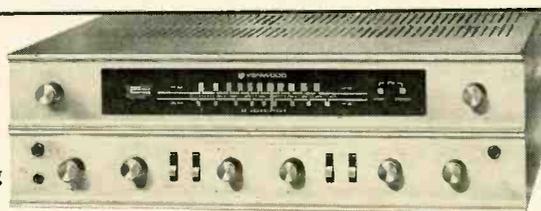
 **KENWOOD**
 IS YOUR *sound approach to quality*



model TK-80
SOLID STATE FM
80 WATTS
MULTIPLEX RECEIVER

- automatic • silicon power transistors • unsurpassed wide frequency range • front-panel switching for 2 stereo speaker sets and earphones • automatic mono-stereo indicator • inter-station muting • \$339.95

model KT-10
ALL SOLID STATE AM/FM
40 WATTS RECEIVER



- automatic silent switching • automatic instant mono/stereo indicator • automatic protection circuit • direct tape monitor • FM AFC control • front-panel stereo headset jack • \$269.95

model KW-55A
AM/FM STEREO MULTIPLEX
RECEIVER



- total 40 watts • silent automatic electronic switching • automatic stereo indicator • nuvistor cascade front-end with 1.8 microvolts • 4 I.F. stages, 3 limiters, wideband ratio detector • \$219.95



model KW-44
AM/FM STEREO
MULTIPLEX RECEIVER

- total 28 watts • exclusive FM stereo monitor • 4 FM I.F. stages, 3 noise limiters, wideband ratio detector • FM automatic frequency control • pinpoint tuning meter • \$179.95

We invite you to find out about all of our quality Receivers, Tuners and Amplifiers from the low-cost economy models to luxury solid state. Visit your nearest Kenwood Franchised dealer or write for a complimentary brochure.

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PRODUCT PREVIEW SECTION —

MISCELLANEOUS-4

RACON

Microphone Stands

Model MS-1C Microphone Floor Stand. Adjustable from 35" to 65", base diameter, 10 1/2". Chrome plated base and tubes; weight, 13 lbs. Price — \$8.70; Model MS-1, same except has gray wrinkle base, \$6.90.

Model MS-1HC Microphone Floor Stand. Heavy-duty model; adjustable from 37 to 66 in.; base diameter, 12 1/4". Largest and heaviest so as to support heavy loads; weight, 16 lbs. Price — \$13.20.

Model MS-2C Microphone Desk Stand. Adjustable in height from 6 to 13 in.; base diameter, 6 in. Chrome plated base and tubes; weight, 2 1/2 lbs. Price — \$5.70. Model MS-2, same except has gray wrinkle base, \$3.60.

Model MS-3G13C Microphone Table Stand. Complete with 13" flexible gooseneck on 8-in. base; all chrome-plated; weight 6 lbs. Price — \$6.90. MS3G13, same except has gray base, \$5.10. Gooseneck is flexible enough to permit microphone to be turned and placed in any position.

Model MC-2 Microphone Swivel Boom. Swivels and tilts so as to project microphone at any angle, 31" from stand; wing-nut adjustment; can be used on any desk or floor stand. Chrome plated, with adjustable counterbalance; weight, 3 1/2 lbs. Price — \$5.10.



ROBINS

Record and Tape Aids

TK-9 Tape Editing Workshop. Includes two tape rewind arms, deluxe splicer, and splicing tape — all on base. Provides a complete splicing and editing system. Base has tape-timing scale. Price — \$24.00.

Phono and Record Care Kit, PK-10. Includes stylus microscope foam turntable mat, strobe and light kit, stylus-force gauge, record covers, and record cleaning kit. Price — \$16.65.

Bulk Tape Eraser, ME-99. Erases to 6 db below normal erase-head levels. Operates on 115-v. a.c.; UL approved; Price — \$43.50

Tape Splicer, TS-8D. Windows to indicate cut and trim position trims slight waist into tape. Furnished complete with 100-in. roll of splicing tape. Price — \$12.75. Six other types of splicers are available; various prices.



ROTRON

Whisper Fan Kit

Measuring only 1 1/2" deep and 4 1/2" square, this fan can exhaust 65 cu. ft. of air per minute from your equipment enclosure, thus ensuring cooler operation and longer component life as well as reduced drift in tuners. Low noise level of only 18 db makes it essentially inaudible in average installation. Complete with installation instructions. Price — \$14.85.

"SCOTCH" TAPE

Three New Series

"Dyanrange" Series tape. Provides brilliant recordings at half the normal recording speed. Use only half as much tape with no loss in fidelity. Type 201, 600 ft. on 5" reel, \$2.80; 1200 ft. on 7" reel, \$4.40. Type 202, in same lengths and reel sizes, \$2.85 and \$5.10, respectively. Type 203, 900 ft. on 5" reel, \$4.25; 1800 ft. on 7" reel, \$7.35.

"Living Letters" Tapes. Three tape lengths available for a variety of uses, including business and personal correspondence. Plastic container provides excellent re-useable mailer or dust-free storage unit. Extra address labels also available. 3" reels, standard 111 tape, 150 ft., 90¢; Double length, 300 ft., (200 tape), \$1.85; Triple length, 600 ft., (290 tape), \$2.95.

No. 290 Triple Length tape. Maximum playing time for each reel size. Especially suitable for continuous recording of lengthy conferences, meetings, conventions. On 1/2-mil tensilized polyester backing, 1800 ft. on 5" reel, \$6.95; 3600 ft. on 7" reel, \$11.95.

MISCELLANEOUS-5



SHURE

Accessories

Model SA-1 "Solo-Phone"— stereo headpiece amplifier. Transistorized unit has inputs for magnetic phono, tuner, or tape; outputs for 2 sets of headphones. On/off switch also controls an a. c. receptacle. Price — \$45.00 net.

Models **M61-1** and **M61-3** transistorized stereo preamps. Furnish voltage gain to permit use of magnetic cartridges into ceramic inputs. Also for microphones and tape-head inputs, with switch to select correct equalization — RIAA, mic, or NAB. Model 61-1 operates on 120-v. a. c. line; Model M61-3 operates on 30-v. battery (included). Gain: RIAA, 46 db; tape head (NAB) 41 db; mic, 63 db. Price — M61-1, \$30.25; Model M61-3, \$29.15.

Model S39-A Vibration Isolation microphone stand. Designed for footlight area of stage and wherever vibration is a problem. Accommodates all Shure microphones. Ideal for remote broadcasting, conference tables, sporting events, and so on. Price — \$15.00.

Model A95-A Cable-Type Transformer. Matches 30/50 and 150/250-ohm sources to 16 Ω -impedance inputs over frequency range of 20-20k cps. Magnetic shield case, 3/4" dia. and 2 1/2" long. Complete with Cannon X2-3-11 and MC-1 connectors. Price — \$10.50.

SONY

PR-150 Magnetic Tape. 1-mil polyester tape with extra heavy Sani-Oxicoat for full-frequency recording. Sony Lubri-Cushion impregnated through coating for optimum head lubrication. Available 1800-, 900-, and 450-ft. rolls and 3-in. mailers.

DR-3 Headphones. Available in low (8-ohm) or high (16-ohm) impedances, and fitted with comfortable ear cushions and head band, and equipped with 3-circuit phono plug. Price — DR-3A (low Z), \$17.50; DR-3C (high Z), \$22.50.

Model HE-2 Head Demagnetizer. Provides high flux density for rapid demagnetization of recording and playback heads. Pole pieces allow access to heads without removing head cover; are covered with soft vinyl to avoid damaging head surfaces. \$12.95.

SWITCHCRAFT

374 Audio Adapter. Adapts a standard phono plug to a "Tini-Jax" phono jack to permit connection of transistor portables to home equipment. List price — \$1.70.

367 Dual Volume Control Adapter. Provides twin-channel high-impedance volume controls

367 Dual Volume Control Adapter. Provides twin-channel high-impedance volume controls for individual control of left and right channels in a stereo system. List price — \$7.50.

501 Transistorized "Mix Amp." A miniature battery powered amplifier designed to overcome loss factor of resistance mixers. Equipped with hi-lo impedance switch; furnishes 3 db of gain over frequency range of 20-20k cps. List price — \$20.00.

05FH81 Stereo Headphone Adapter Cable. Two standard two-conductor molded phone plugs wired to a three-conductor jack. Adapts two-circuit stereo headphone plug to separate single phone jacks as found on many stereo tape recorders; list price — \$4.35.

25FF25 Stereo Cable Assemblies. 3-ft. length of small-diameter stereo cables tandem in common gray jacket, and fitted with color-coded plugs. Also available in 6- and 10-ft. lengths. Makes neater interconnections between stereo components, since it halves the number of separate cables. List price, 3-ft. length, \$3.25.

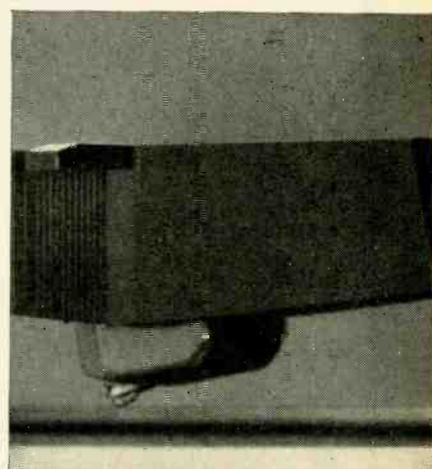
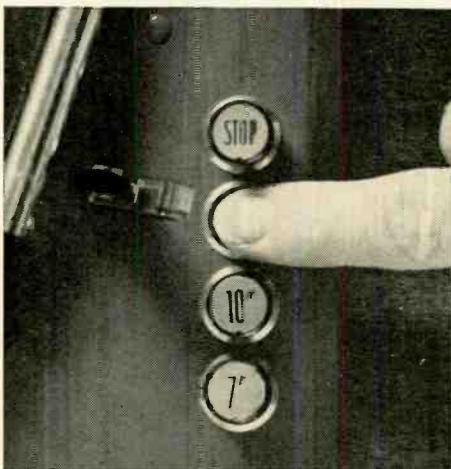
THE TALL CO.

Tape Splicers

Precision machined tape splicing blocks — Model KP-2, plastic, for 1/4" tape, \$3.50; Model KS-2, metal, \$7.50; Model KS-3, deluxe version, metal, \$9.00. Model KS-3.5, similar, but for 1/2" tape, metal, \$25.00.

VEGA ELECTRONICS CORP. Vega 212 "Soundservo"

A self-powered automatic-volume-control amplifier for any sound system. Installed between microphone and amplifier, this unit controls level, reduces feedback, prevents overloading. High or low impedance, with response within ± 1 db from 20 to 20k cps, and with less than 0.1% distortion; attack time, less than 1 millisecond; release time, 2 seconds nominal; compression range, 50 db. Dimensions: 4 5/8" wide, 2 3/8" high, and 6 7/8" deep. Price, \$125.00.

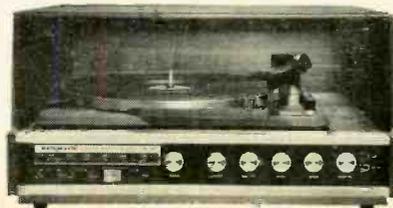


That's all we had room for

Solid-state FM stereo tuner, solid-state 36-watt stereo amplifier, Miracord automatic manual turntable with pushbutton controls, and Elec diamond-stylus cartridge, all in a cabinet no larger than would be required for the turntable alone. That's what's so remarkable about transistor electronics.

Price is \$339.50 in walnut cabinet with plex glass lift-cover, ess speakers. Any good pair will do. We recommend the Benjamin 208's, only \$45.50 each. Benjamin Sterec 200, without FM, is \$229.50. See your hi-fi music dealer, or write: Benjamin Electronic Sound Corp., 80 Swalm Street, Westbury, New York

The Benjamin Stereo 200 FM

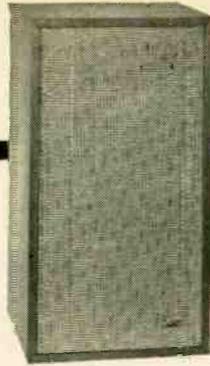


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"PARDON US FOR ASKING...but

Have you auditioned these loudspeakers lately?"

If you are partial to full concert hall sound, listen to the brilliant repertory of true tonal values built into the "Mark V" and "Del Mar." Possibly we put in too many hidden values, but otherwise the extra measure which we believe essential might have been lost. We weren't willing to take a chance. Are you?



Mark V



Del Mar

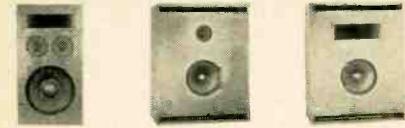
MARK V — Dual crossover network. Frequency response 30 to 17,000 cycles. 14" wide x 26½" high x 12" deep. Oil walnut finish. \$169.95

DEL MAR — Frequency response 40 to 15,000 cycles. 23½" wide x 23¼" high x 11½" deep. Oil walnut finish. \$79.50. DEL MAR I... \$109.50



LOUDSPEAKERS

FRAZIER INCORPORATED
2649 BRENNER DR., DALLAS 20, TEXAS

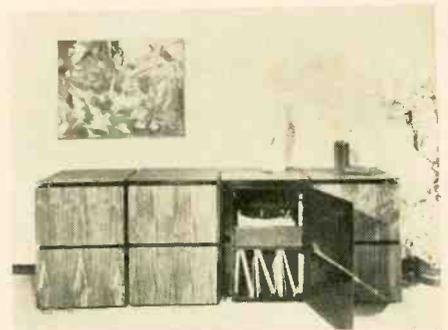


UTILITY VERSIONS OF BOTH THE MARK V AND DEL MAR
You can build your own cabinet or your own built-in system and be sure of true concert hall sound.

Circle 143 on Reader Service Card

PRODUCT PREVIEW SECTION —

MISCELLANEOUS-6



TOUJAY

Equipment Enclosures

Offering a wide range of audio component housings and cabinets custom adaptable to individual needs. A variety of styles are available in walnut, teak, and rosewood.

CECIL E. WATTS

Record Cleaning Equipment

"Preener" — a simple off-tumble record cleaner for pre-play record care. Price — \$3.00.

"Dust Bug" — an on-tumble record cleaning system. Am is mounted on tumble base and carries combination brush-and-pad which continuously removes dust and dirt while the record is playing. Price — \$6.00.

"Parastat" — the ideal record cleaner for records which have an accumulation of "gunk" and grime and dust. Parastat is designed to rejuvenate them. Price \$15.00

TAPE GUIDE

(from page 73)

0 vu at the 1 per cent distortion point.) If the bias voltage specified by the service manual produces an excess of highs on the tape, you would increase bias rather than decrease it.

The foregoing will "optimize" performance at 7.5 ips. This may result in appreciable treble loss at lower speeds. You can, if you wish, get better treble response at lower speeds by decreasing bias. In other words, you may want to adjust bias to a point which represents a compromise between the requirements at high speed and slow speed.

High Output Tape

Q. The advertisement for a certain brand of tape mentions an output about 7 to 12 db higher than conventional tape, with 25% better high-frequency response. Is this claim exaggerated? I ask because I am trying to improve the signal-to-noise ratio of my tape recorder through the use of high output tape.

A. It is quite possible for the advertising claim of the tape to which you refer to be valid. High output tape tends to permit about 6 to 8 db higher recorded level on the tape for a given

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amount of distortion, compared with conventional tape of good quality. Inferior tape may permit a few db less recording level, for the same amount of distortion, than comparable tape of good quality. Hence the claimed superiority of 7 to 12 db makes sense. As for the claim of 25 per cent better high frequency response, this too is quite possible. After all, a 25 per cent improvement, in terms of voltage output of the playback head, represents a rise of only 2 db.

While the use of a high-output tape may improve your signal-to-noise ratio by 7 db or more, at the same time such tape is more subject to print-through than conventional tape. Therefore you have to be more careful not to exceed maximum permissible recording level as indicated by the record level indicator.

Impedance of Heads

Q. How can I determine if the tape head that I have is a low- or high-impedance type?

A. One way to check the impedance is by means of a ratio bridge, such as that found on some capacitor checkers. You would require a known inductance, and by means of the bridge you could obtain, with fairly good accuracy, the ratio of the unknown inductance to the known inductance. Another method is to put a 0.05 μ f capacitor in series with the inductance (the head), put a 1 kc signal across the two components, and measure the voltage across each component. If the voltage across the inductance is roughly of the same order as the voltage across the capacitor, or larger, the head is high impedance. This is based on the fact that a high-impedance head is typically about 0.5 henry (or higher), and therefore has about the same reactance as a 0.05 μ f capacitor at 1 kc. If the voltage across the head is much lower than across the capacitor, the head is low-impedance.

Correct NAB Equalization

*Q. I own a **** tape recorder, and a reading of the schematic indicates that its playback equalization is close to the NAB curve. But I would like to know for certain, and if I am wrong I would like to add an extra circuit to provide NAB playback equalization for recorded tapes. Will you be kind enough to tell me whether this machine has NAB equalization.*

A. I have no schematic of your machine. However, you can probably check for yourself by noting whether the playback equalization circuit contains a capacitor and resistor combination with a time constant of 50 microseconds (or close to that). To illustrate, if there is a 0.01 μ f capacitor and a 5,000-ohm resistor, multiplying one by the other gives a product of 50 (micro-

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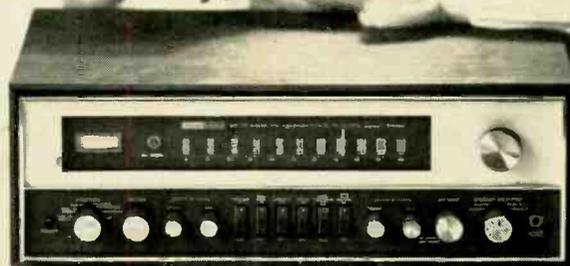
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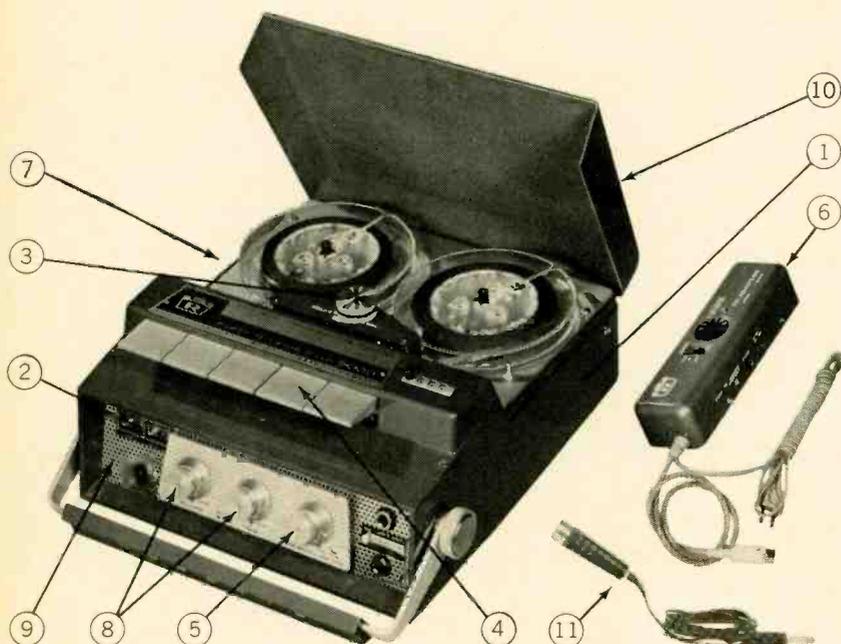
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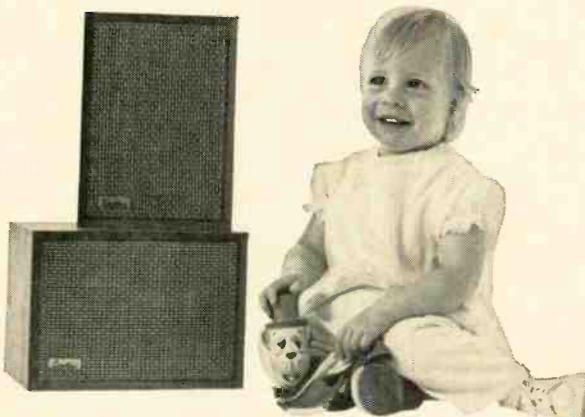
(from page 21)

at sub-sonic frequencies, which results in almost no phase-shift in the transformer throughout the spectrum. This was experimentally verified by applying feedback to the ribbon.

A Philbrick "Booster" type PP66 (push-pull emitter follower, drawing a very small no-signal current) is incorporated to bring the output impedance down to about 30 ohms. This effectively immunizes any cables to fields and transients in their environment. The total voltage gain of the system is about 3900, delivering approximately 30 millivolts per dyne/cm². Frequency response of the transformer-plus-amplifier-plus-booster is within ½ db from 30 cps to 20 kc. Limiting occurs at about 7 volts rms, corresponding to a very loud signal indeed. The over-all gain can be reduced to any convenient figure without affecting the signal-to-noise ratio by changing one resistor in the amplifier feedback loop. The noise level is at least 52 db (unweighted) below 1 dyne/cm². The normal signal level is such as to permit (and require) connection directly to the

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unbalanced line input of equipment such as the Ampex 351 recorder, thus bypassing a transformer and a stage of amplification. Power is furnished to the self-contained system by two miniature 15-volt batteries clipped to the microphone case; their life is 12 to 20 hours.

Since the velocity component of sound (to which a ribbon microphone responds) rises disproportionately when sources are nearer than one wave length from the microphone, a controllable means of rolling off the bass response is necessary for close miking of bass sources. This is accomplished here by

switching in an additional feedback circuit. A current derived from the signal output is applied directly to the ribbon. At medium and high frequencies all the feedback current is bypassed to ground by a suitable capacitance; as the frequency drops, an increasing portion of it passes through the ribbon, limiting its motion and signal (Pat. applied for).

Anechoic chamber response curves are not yet available for this microphone; however it can be said without reservation (as in all articles by designers of new audio equipment) that performance in actual use is superb. This

is confirmed by an independent professional user, whose interest caused the project to progress beyond its original intent; these microphones are now in limited production.

The author wishes to acknowledge the vital assistance of the following individuals: Mr. Byron White, Newton Engineering Services, Inc., transformers; Mr. Bruce Seddon, Philbrick Researches Inc., operational amplifiers; Mr. David B. Hancock, recording engineer, for stimulating criticism and encouragement.

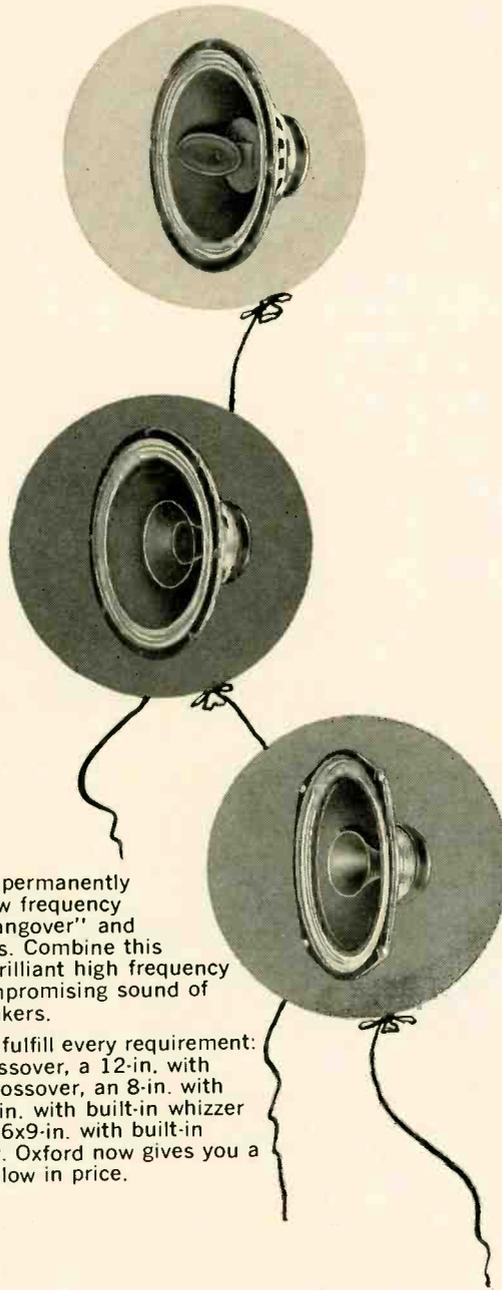
BIBLIOGRAPHY H. F. Olson, "Acoustical Engineering," D. Van Nostrand, 1957 ed. Olson and Preston, Velocity-type Microphone, U.S. Patent 2,572,376. Shorter and Harwood, "The design of a ribbon-type pressure-gradient microphone," BBC Engineering Monograph No. 4, Dec. 1955. R. Williamson, "A professional condenser microphone," AUDIO, July, 1963.

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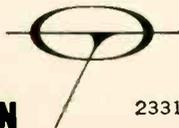
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SOUND & SIGHT

(from page 28)

pictures for commercial and educational purposes.

Before the advent of the new movie system, cameras were difficult to load. The new Super 8 film is supplied in cartridges which are simply dropped into place in the camera, and exposed for the whole 50 feet without the need of turning the cartridge over after 25 feet, as with the old system. This feature eliminates any possibility of accidental double exposure and fogging of film, two common problems in previous movie systems.

Automatic exposure eliminates another of the problems which beset the layman. Every exposure is correct because the camera sets itself automatically in both natural and artificial light. Winding the spring is no longer necessary, for the cameras are electrically driven, eliminating the annoying spring rundown in the middle of a scene.

Automation with a capital "A" makes this system easy to use. The film producer is relieved of the chores of movie making and can concentrate entirely on the subject matter. Another advantage is that outside production of films, often costly and inefficient, can be eliminated. No one knows your field and the message you wish to impart better than your organization. It is difficult and time consuming to convey your thoughts, ideas, and concepts to an outside producer. Freed of the technical aspects of filming, you can become your own film producer as did Mr. Hyman. A little knowledge and a few "tricks of the trade"—both of which we hope to provide in future columns—are all that is required.

It is also interesting to note that many of the methods and techniques which will be provided are equally applicable to motion pictures or video tape recording, another field which we feel will open new horizons to the readers of AUDIO.

AUDIO ETC

(from page 11)

mind you, with nothing more than a shoestring of an antenna, a piece of loose wire which I taped onto the edge of a convenient picture frame, up above the tuner's location.

So statistically, I'm talking about a thing that, for most listeners, doesn't exist. Most of us live in big-city complexes. By far the great majority of us set up our stereo within some metropolis, or in the suburbs, near and far, or the exurbs and the outer stixes or the not-so-distant shopping towns and rural developments. That's where we live. And so stereo obviously presents no noise problems at all. None at all—if you discount the minority people, those little clusters of isolated tuners-in here and there out in the vast open spaces, in the hills, on the plains, in the deserts, out where the mail is delivered RR (Rural Route—it used to be called RFD, for Rural Free Delivery) and where the water comes from your own well, the garbage goes to the pigs or an electric grinder and the "sewer" is a thing buried under the front lawn.

People who live in these places can have stereo too, but they'll have to trust to luck. After all, FM was never meant for them. The whole idea, in the first place, was to limit FM coverage to a thirty-mile radius, roughly speaking, and in the broadcast economy, the principle still holds.

Don't I know. Listen to the weather report on a Philadelphia station, 200 miles away—for Philadelphia and the suburbs. What else? They don't mention Connecticut. When you shop, visit Sears, or Wanamakers, they say, Sears-Philadelphia. Not Sears-Torrington, my local outlet. We don't have any Wanamakers around my region. The advertisement is wasted on us. It's for the local trade. Stop for a coke at the Super-Drive-In, so convenient, right on the Purlmutter Highway, across the bridge—you can't miss it. *What bridge?* I'm only a Connecticut Yankee snooping around in somebody else's Pennsylvania FM air. I don't even know the local bridges down there.

And yet. . . . What with increased tuner sensitivity, plenty of special antenna equipment and improved FM transmission, the fringe areas have been opening up, in spite of the system, in these last few years. I'm not the only person who listens routinely to "local" FM stations 100 miles away. More and more do every year, and the lesser distances in proportion. We are becoming

a rather vocal minority. And we are the ones who now find that stereo listening offers noise problems, in the background.

Signal Power

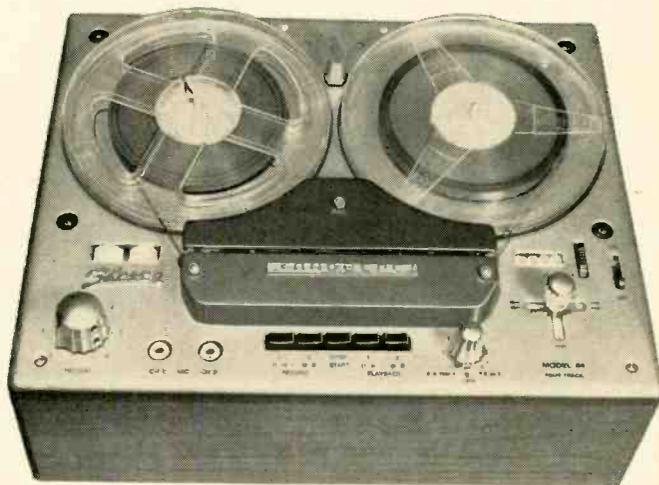
I don't need to account for the difference between city and country stereo. There is that unfortunate 20 db-plus loss of effective signal strength, as between mono and stereo. A stereo station *heard mono* is down less than 1 db.

And in the city, close to the transmitters, there is enormous power to spare. The ratio between close-up sig-

nal strength, within the city limits, and fringe-area signal strength is absolutely huge—it is amazing that tuners can be designed with such an enormous variation. Actually, I think we should marvel that stereo can be received at all at a distance, and that its worst listening fault is no more than a quiet, steady, persistent fffffffffffff in the background, as opposed to the complete silence of mono reception.

We outside listeners (and some who are unfavorably placed within the urban listening area) should be thankful for what we do get.

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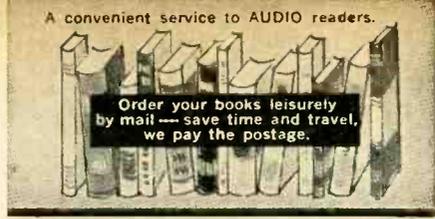
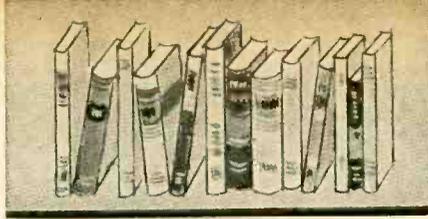


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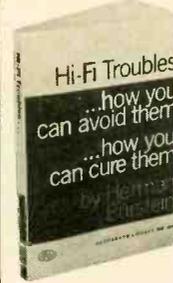
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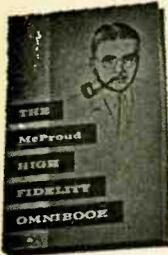
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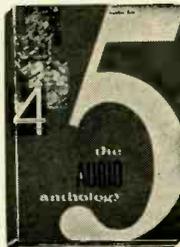
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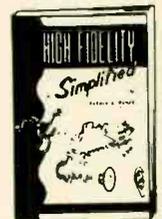
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Caruso

I'm thankful all right. But I still switch to mono when I hear that fffffffffffff. Reasonably or unreasonably, I object to it. And the silly thing is that I wouldn't worry if it were *worse*. Stereo would then simply be beyond any temptation. What is annoying is that I get so close to perfect stereo—and yet can't quite make it. Tantalizing! I wonder how many listeners go through this with me? Excellent stereo reception—*except* for that eternal slight background noise.

Out of curiosity, I tried to pin down its effect in terms of recordings, new and old. The background in my stereo, I quickly found, was higher in level than anything on LP records today. Our LP's are near-silent, mostly. The noise was worse than the average ten-year-old LP, too. I got out a few, just to see. Pops and crackles galore—but still, the listening was easier than the broadcast stereo.

Finally, I pulled out an LP reissue of a batch of early acoustic Caruso discs, taken off the original wax masters. The gentle hiss of those ancient records almost exactly matched the sound of stereo via FM.

And to complete the comparison, I tried a few of my best old 78 shellac discs, from the electrical era. Yep, just as I thought. The fringe-area stereo "surface noise" almost exactly matches the surface sound on a good-quality pre-war 78-rpm shellac, say around 1937.

So you see why some of us get rather agitated when we hear it. This stereo background noise, slight as it is, gentle as it may seem in comparison with a real blast of inter-channel roar, nevertheless takes us way back, to a sound we hoped we'd never hear again. The uncomplimentary popular term for it in those days was "record scratch," and we went to enormous lengths to get rid of it—including removal of the entire higher end of the sound spectrum. So can you be surprised if we remove stereo itself now, turning back to FM mono whenever we hear that gentle fffffffffffff mixed into our stereo music?

If you live in the city or nearby, just ignore me. I'm not even talking to you. Your stereo is *silent*.

My thanks to two manufacturers in particular, who let me use their tuners month after month to see what was on the air. H. H. Scott's 312 Stereomaster, with four nuvistors and the tuning meter, was one of them. And I had two of the little KLH Model Eighteen all-transistor tuners, one in the city and one up-country. These three helped me immeasurably, along with more transitory listening to other tuners.

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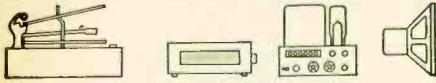
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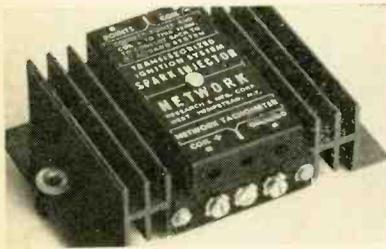
from the February, 1965, issue?

"NETWORK" SPARK INJECTOR

With the curiosity indigenous to a long-time hi fi enthusiast, this observer was naturally intrigued by the advertisement of this product in a recent issue. "High Fidelity" performance from an automobile appeared to be a new category of criteria.

Accordingly we obtained one for "test," not knowing just exactly how one would measure performance of such a device with the sort of objectivity we attempt to attain with the usual hi fi component.

In the first place, installation is slightly simpler than claimed in the advertisement, since it took just eight minutes to put it in place, connect the four wires, and start the car—a 4600-lb 1961 model. It started off immediately—better, if anything, than usual. Then, before essaying any long-trips, we "broke it in" around town for long enough to have confidence that it would continue to work—no real problem if it hadn't, really, since it is only necessary to move two wires from their usual terminals to a third one, all of which are readily accessible, to restore the normal ignition system to operation.



After sufficient local driving to establish confidence, we went on a couple of 450-mile trips. There was no noticeable performance difference up to 60 mph, but above that when acceleration usually drops off, it was another story. Step on the gas at 60 and the car simply jumped—about like it usually did at 30. With the usual test figure of time to reach 60 from a standing start, we measured 10 seconds, and another six from 60 to 80—sports-car performance from the "family sedan." A more important figure for the user is the gasoline mileage, which showed an increase of 13 per cent over the normal ignition system. This was on a reasonably accurate controlled test. On a 500-mile trip, one way was with the Spark Injector and the return on normal ignition.

We had previously used another type of transistorized ignition for some 15,000 miles without changing plugs or points, and both were still like new—no point wear at all. With no stress on the points they should last until mechanically worn out, but not from pitting of the contacts.

Later we had the opportunity of observing a bench comparison of the Spark Injector with a normal ignition system. At engine speeds of over 4000 rpm, the normal-system spark became erratic, and ceased altogether at about 5000. With the Spark Injector, the spark was still "fat" up to 7000 rpm, which is well above any speed a normal engine ever reaches.

With increased gasoline mileage, snappier acceleration at high speeds, easier starting, and longer spark-plug and point life, we are most enthusiastic over the Spark Injector.

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Ignition Division

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JUNK BOX

(from page 25)

and the damping factor for this meter is:

$$DF = \frac{1}{\text{Overshoot}}$$
$$= \frac{1}{0.26}$$
$$= 3.85.$$

Another meter had an overshoot of 20.5 per cent and a damping factor of 4.9. In both cases, the amount of overshoot remained relatively constant as battery voltage was reduced until very low values of E and R_b were used. This shows that the damping provided by air and eddy currents predominate until the damping resistor, R_b , is reduced to a value approaching that of the meter resistance, R_m . For comparison, a standard VU meter has an overshoot of 1 to 1.5 per cent, which means the damping factor is 100 to 67, respectively.

In summary, the damping factor of a junkbox meter may be increased for a particular application by shunting the meter terminals with a low resistance. Of course this changes the calibration of the completed instrument and the value of other series and shunt resistors in the external circuit must be changed accordingly. Conversely, the damping factor may be reduced by removing all shunts and using the largest possible value of series resistor in the external circuit. In addition, the damping factor may sometimes be appreciably decreased by connecting a capacitor in parallel with the external series resistor. Because of the unknown factor of meter coil inductance, the value of this capacitor is best determined by experiment. AE

ABOUT MUSIC

(from page 14)

portant operatic conductor, Chopin, Liszt, and Beethoven himself were concert pianists; and William Schuman is the president of a complex center for the performing arts. Come what may, one has to earn a living.

In Beethoven's Utopia, the question of survival would be dealt with in a straightforward manner: there would be, as Beethoven saw it, "a single Art Exchange in the world, to which the artist would simply send his works and be given in return as much as he needs. As it is, one has to be half a merchant on top of everything else, and how badly one goes about it!"

Some composers could have given the Bonn master pointers on how to operate in the mercantile world. Palestrina was a furrier and a leather merchant;

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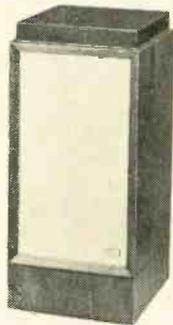
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AUDIO • AUGUST, 1965

Clementi a piano manufacturer; Charles Ives a brilliant executive of an insurance firm. No amount of advice probably would have helped Beethoven develop business acumen, although he was shrewd enough in small ways.

Setting aside the income earned from non-musical jobs, let us focus our attention on the money a composer gets strictly for composition. Today, a successful composer can count on commissions from foundations, private sponsors, European radio stations, government-subsidized opera houses and other sources. Some composers are booked years ahead of time. Gunther Schuller is a case in point: on his list of commissions are an opera scheduled for performance in Hamburg next year, a Shakespearean work for the Canadian Broadcasting Corporation, a symphony for the Dallas Symphony, an "American Triptych" for the New Orleans Philharmonic, and others.

Royalties from recordings, performances, and publications, of course, play an important role, but the Copyright Law of 1909, framed before the days of television, radio, and recording, contains antiquated and unfair provisions. A long-awaited revision of the law is in the process of being hammered out in Congress.

The machinery set up for the distribution of money to creative artists cannot possibly keep up with the needs of the American composer. If he is a composer of orchestral and other large-scale works, copious funds are needed merely to mount the works. After the composer has written out the full orchestral score (a laborious and time-consuming process), parts must be copied and proofed. Orchestral rehearsals are scheduled, and finally the work is performed in concert. If the composer is fortunate, his music will be recorded. Until the Rockefeller Foundation came through with a special grant, Charles Ives's Fourth Symphony might still have remained unperformed—years after its completion. The grant paid for the copying and extra rehearsals needed to perform this highly intricate score.

But commissions are not that easy to come by. In 1961, the New York City Opera Company offered a prize for the best opera submitted to them. Two years later they received 150 manuscripts, but the jury appointed by the Opera Company turned them all down. The thought of all the months spent in collaboration between composers and librettists, as well as the actual writing down of the lengthy scores, is discouraging. Until the commissions and prizes begin to flow, however, a world of jobs awaits the composer. The peaceful, tree-shaded veranda belongs to the past.

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STUDIO TALK

by ALEXIS BADMAIEFF

Chief Engineer
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A BIG OR LITTLE CONDENSER MIKE?

We have heard that when using condenser microphones, some musicians insist on the large "impressive" looking models. Unfortunately, when it comes to microphones, large size is not the measure of quality. Quite the opposite! A large mike with a large diaphragm has inherent limitations when compared to the miniature "Lipstik" mikes which we manufacture. In fact, we'll make this unequivocal statement: *When using a condenser mike, you'll obtain better pickup along the entire audible spectrum, especially in the high frequency region, with a small diaphragm.*

WHY SMALL SIZE OF DIAPHRAGM IS CRITICAL FOR QUALITY WORK

Parallel Incidence (sound arriving parallel to plane of diaphragm) is an extreme condition that can ruin the best planned session, because all wave lengths equal to the diameter of the diaphragm will strike from edge to edge, 180° out of phase. The larger the diameter, the lower the point at which phase cancellation occurs.

Perpendicular Incidence (sound arriving perpendicular to plane of diaphragm) is ideal, regardless of size of diaphragm. But unless you're dealing with a single, fixed sound source, the ideal incidence is pure theory. Add a multi-sound source like a widely dispersed orchestra, and you better look for the smallest mike available.

Random Incidence is any incidence between the fairly hypothetical parallel and perpendicular incidences. In practice, random incidence of varying angles is universal in microphone work. Therefore, you almost always work with staggered phase due to sound waves striking the diaphragm at different angles. The result is of course diminished hf response. What's important here is not the fact that hf drop-off will occur, but *where* it occurs. With a large diaphragm, it occurs lower in the spectrum; with a small one, it occurs virtually beyond the usable range. For example, in condenser mikes with diaphragms 1" in diameter or larger, frequency drop-off occurs at 10 kc. On the other hand, a mike with a 1/2" diaphragm (such as our M-20 or M-30), placed in an identical position, drops off at 20 kc!

HF DROP-OFF IS INVERSELY PROPORTIONAL TO SIZE OF DIAPHRAGM

The smaller the diaphragm, the less subject it is to directivity of the sound source. That's why Altec manufactures two condenser microphone systems—the M20 Omnidirectional and M30 Cardioid—employing a tiny 1/2" diaphragm. Not only are these mikes considerably smaller than most European makes, they're better made to boot! We recently measured a popular European condenser mike against our M30. The foreign mike dropped-off badly after 10 kc; ours was flat to 18 kc! We also measured a 9 db advantage in signal-to-noise ratio in our mike (-61 dbv vs. -70 dbv). Altec condenser mikes are designed to meet the demand of American recording and broadcast engineers for superior performance throughout the audible range, quite naturally including a superior high frequency response.

ALTEC LANSING

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ANAHEIM, CALIFORNIA

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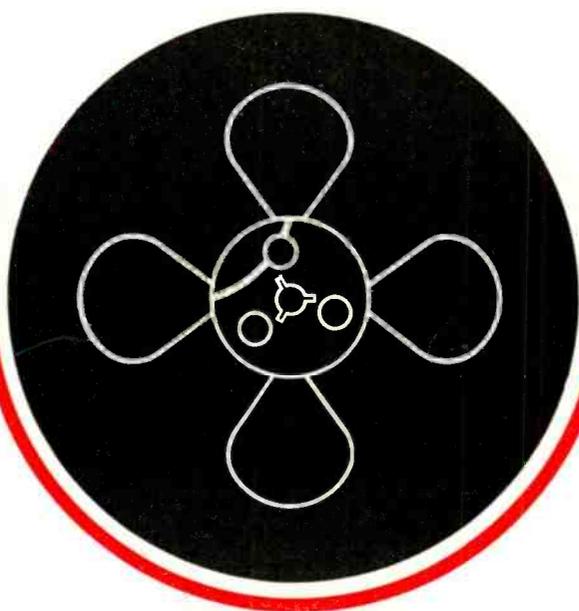
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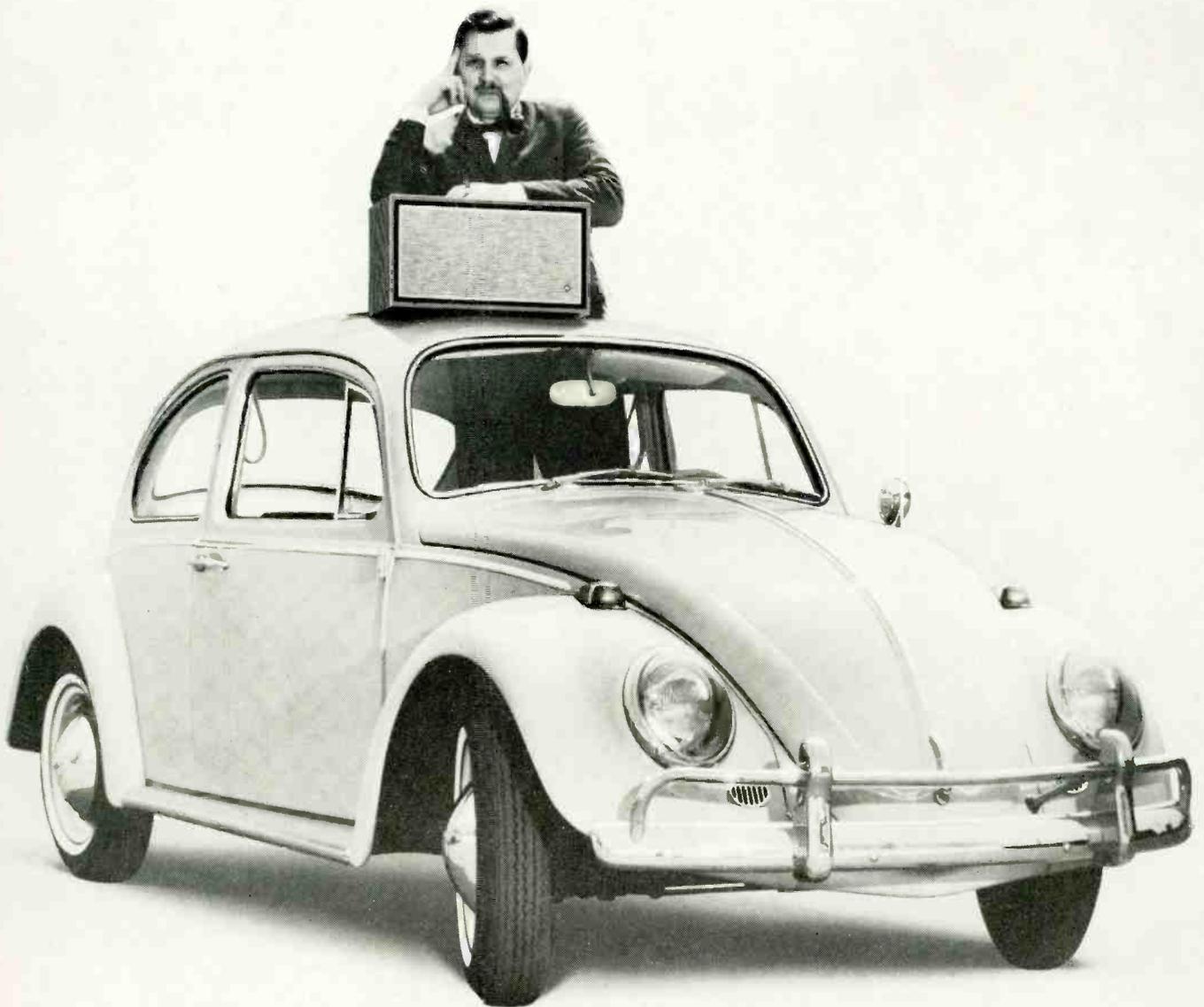
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