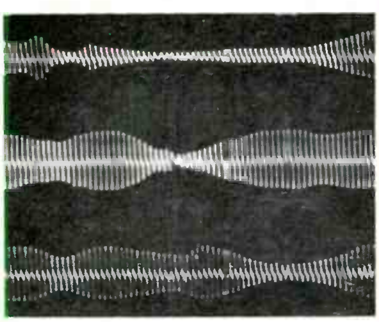
# AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

MARCH, 1954

50c



*Careless splicing of magnetic tape can result in pops and noise as shown by the oscillogram. For corrective measures see page 19.*

*Composer-conductor Igor Stravinsky's "The Rake's Progress" is possibly the first major composition in history to be heard and judged by the public solely in a recorded version. See* The Record Revolution and Music, *page 29.*

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PROBLEMS INVOLVED IN MAGNETIC TAPE RECORDING

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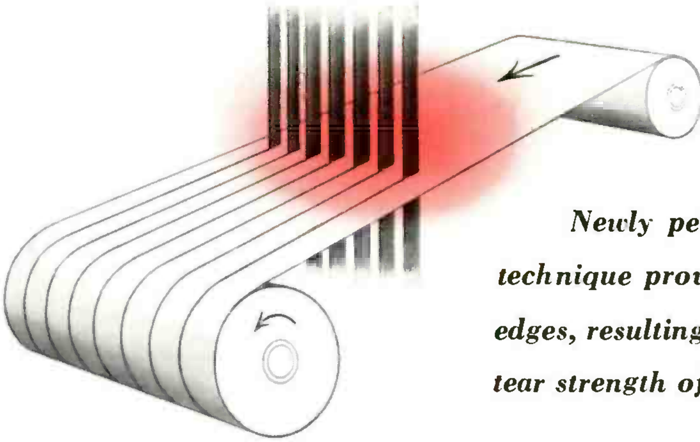
# NEW HOT-SLITTING PROCESS

## GIVES audiotape EXTRA STRENGTH



***Newly perfected thermal-slitting technique provides smoother, cleaner edges, resulting in increased break and tear strength of plastic base Audiotape***

IN THE manufacture of Audiotape, particular care has always been given to the slitting operation, in which the processed tape is cut into reel-size widths. Precision straight-line slitting has been one of the reasons why Audiotape tracks and winds perfectly flat and has no fuzzy edges to impair frequency response.

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MARCH, 1954 VOL. 38, No. 3
Successor to RADIO, Est. 1917.

# AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

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AUDIO ENGINEERING (title registered U. S. Pat. Off.) is published monthly at 10 McGovern Avenue, Lancaster, Pa. by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary. Executive and Editorial Offices: 204 Front St., Mineola, N. Y. Subscription rates—United States, U. S. Possessions and Canada, $3.00 for 1 year, $5.00 for 2 years; elsewhere $4.00 per year. Single copies 35c. Printed in U. S. A. All rights reserved. Entire contents copyright 1954 by Radio Magazines, Inc. Entered as Second Class Matter February 9, 1950, at the Post Office, Lancaster, Pa. under the Act of March 3, 1879.

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# AUDIO PATENTS

RICHARD H. DORF*

This writer has no intention of getting into a controversy over the merits, if any, of eliminating amplifier output transformers. There seems, in any case, to be some interest in the subject, even to the production of at least one commercial version of such an amplifier. So, like the printer whose traditional oath of office requires him to follow the copy even if it goes out the window, we are determined to be a faithful reporter and pass on some information which turned up in two recent patents which will be of interest to OTL enthusiasts.

Both patents are the brainchild of Wallace H. Coulter and were sent in to this department by J. R. Coulter of Chicago's Coulter Electronics. The first patent was British and the second American, both covering the same invention. It may be of some interest to someone to know that the British patent (No. 688,273) was filed a year later than the American one (No. 2,659,775) and was issued some eight months earlier. Apparently the British Patent Office is somewhat less overworked than our own in Washington.

The patents are concerned with the type of output circuit which employs two power tubes in series. *Figure* 1 shows a general schematic of this sort of circuit, of the type which existed in the "prior art," and upon which Mr. Couter's scheme is an improvement.

The workings of the circuit of *Fig.* 1 are not hard to comprehend. With no signal input to the stage and with identical tubes and cathode resistors for $V_1$ and $V_2$, as well as identical power sources for $B_1$ and $B_2$ (batteries are shown only for convenience), we have a balanced bridge circuit and no current flows through the load. Currents from the power supplies flow equally through the two tubes, and through the load in opposite directions, so that net current through the load is zero.

When a signal is applied to the transformer primary it is applied to the two grids in phase opposition—one grid goes negative during one alternation with respect to its cathode while the other goes positive with respect to *its* cathode. Current is thus decreased in one tube and increased in the other, as the result of which cancellation in the load no longer exists and a net signal appears across it. During the next alternation the unbalance is in the other direction so that the unbalance signals across the load vary in phase to produce a true a.c. output signal. Bypass capacitors *C* simply provide a low-impedance path around the power supplies.

As far as the load is concerned, the two tubes are in parallel for a.c. since the right end of the load in *Fig.* 1 is connected both to the cathode of $V_1$ and the plate of $V_2$. It therefore sees an impedance equal to only 25 per cent of the impedance of a single tube. This is low enough to allow direct connection to a voice coil which is in the range of 100 ohms or so and results can even be obtained with a 16-ohm voice coil. At the same time, since the output signal is made up of the resultant of two outphased tube outputs, the same even-harmonic cancellation is obtained as in a standard push-pull stage.

The disadvantage of the particular arrangement, however, is the necessity for an input transformer, something generally frowned on in present-day audio practice because it increases expense and weight and affects phase and frequency response so as to limit the possible negative feedback. The desirable solution is to use a vacuum-tube phase-splitting arrangement for the input.

But here we run into another problem. The grid signals in *Fig.* 1 come from transformer windings, neither end of which need be grounded, so that each signal can be applied between grid and cathode. With a tube input, however, the outphased input signals exist between the splitter output points *and ground.* And if we apply signal to the upper tube of *Fig.* 1 between its grid and ground, $V_1$ will act as a cathode load for $V_2$, causing degeneration in $V_2$ so that its output signal will not be equal to that of $V_1$.

The use of a phase-splitting system and compensation for the resulting degeneration is the essence of the Coulter invention.

* *Audio Consultant, 255 W. 84th St., New York 24, N. Y.*

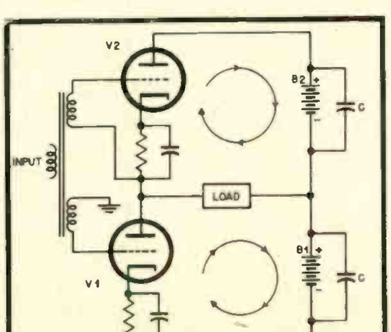


Fig. 1

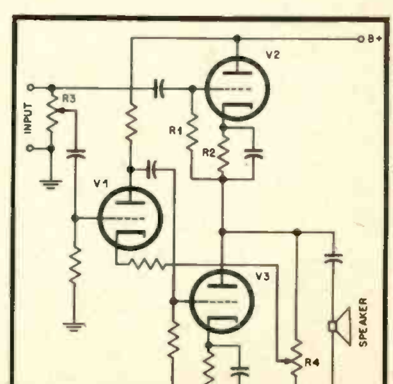


Fig. 2



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One preferred embodiment of it appears in *Fig.* 2.

Let us first clear up the identity of the load connection with that in *Fig.* 1. $V_2$ and $V_3$ in *Fig.* 2 are the same as $V_1$ and $V_2$ in *Fig.* 1. The grounded end of the speaker voice coil is connected for a.c. both to the cathode of $V_3$ and the plate of $V_2$, since both these points are bypassed to ground through large cathode capacitor and large power-supply filter capacitor, respectively. The audio current through the voice coil is thus opposite in phase from the two tubes (assuming they are excited in phase opposition) and net signal through the load is the result of unbalances caused by increase of conduction in one tube and decrease in the other, as before.

The input signal, single-ended, is fed directly to the grid of the upper tube $V_2$. While $R_1$ provides a d.c. path from this grid to the bottom of the tube's cathode resistor so that the bias is only that resulting from cathode resistor $R_2$, the input signal is applied between grid and ground. That being so, $V_3$ causes cathode degeneration, reduces the plate-current variations of $V_2$.

Phase-inverter tube $V_1$ is provided to transmit the same input signal to the grid of $V_3$ 180 deg. output of phase with that on the grid of $V_2$. The output of the phase inverter is between $V_3$ grid and ground, but there is no degeneration problem with $V_3$ since its cathode is bypassed directly to ground. $R_3$, across the signal source, is merely a means of regulating the input to $V_1$ so that the signals applied to the grids of $V_2$ and $V_3$ will be equal in level.

The method Coulter takes to equalize the space-current variations in the two output tubes is to balance the degeneration existing in $V_2$ by introducing a compensating degeneration in the signal of $V_3$. To do this he first places a resistor $R_4$ across the output. $R_4$ is of considerably higher value than the voice-coil impedance so as not to interfere with speaker operation. The voltage taken from $R_4$ by the slider causes negative feedback in $V_3$ in the following way.

Assume on one alternation that the main input signal is positive. It is applied to the grid of $V_2$, making the $V_2$ plate negative. The $V_2$ plate is connected to the bottom (ground) of $R_4$, making ground negative with respect to the upper end of $R_4$ when considering only $V_2$. Thus, $V_2$ makes the upper end of $R_4$ positive with respect to ground.

The same main input signal is phase-inverted by $V_1$, placing a negative signal on the grid of $V_3$. The plate of $V_3$ is thus positive with respect to its cathode, making the upper end of $R_4$ positive with respect to ground due to $V_3$. Thus, for this alternation the voltage tapped from $R_4$ is definitely positive with respect to ground.

This positive voltage is applied to the cathode of phase inverter $V_1$. This decreases the $V_1$ current flow, making the plate more positive, and likewise making the grid of $V_3$ more positive. Since this is 180 deg. out of phase with the original signal appearing at the grid of $V_3$, it constitutes negative feedback for $V_3$ but does not affect $V_2$. The slider on $R_4$ is adjusted so that its negative feedback to $V_3$ just offsets the cathode degeneration imposed on $V_2$ by $V_3$, after which operation is symmetrical and the full advantages of the series-connected circuit are realized without an input transformer.

Mr. Coulter (J. R. of the letter which accompanied the patent copies) says that fidelity of this circuit is better than that of transformer-coupled push-pull output stages. A single 6AS7 duo-triode will provide 8 to 10 watts into a 150-ohm voice coil

(*Continued on page 53*)



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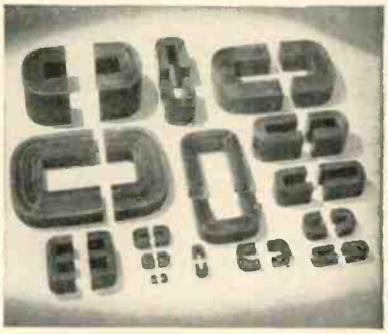
# ARNOLD MAGNETIC MATERIALS

## TYPES "C" AND "E" CUT CORES



Arnold "C" and "E" Cores are made from precision rolled Silectron strip (highly oriented silicon steel) in 1, 2, 4 or 12-mil thicknesses and a wide variety of window sizes and core areas, for high and low-frequency applications. Sizes range up to 10 lbs. in 12-mil strip, and from fractions of an ounce to hundreds of pounds in the thinner gauges. Cores wound from ultra-thin strip (down to ¼ mil or less) can also be supplied.

Insulated strip of the proper width is wound on a mandrel, then heat treated, bonded and cut into halves. Careful control results in accurately dimensioned and matched core halves whose effective air gap at the butt joint is very small.

In 3-phase applications, the use of "E" Cores provides weight and size reduction, as well as higher efficiency and possible cost savings. Rigid standard tests are employed for both "C" and "E" types of cores, and special tests where required.

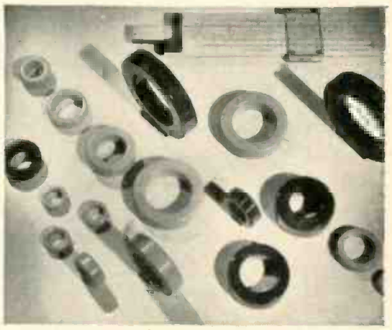
## TAPE WOUND CORES

Depending upon the specific properties required, Arnold Tape Wound Cores are available made of Deltamax, 4-79 Mo-Permalloy, Supermalloy, Mumetal, 4750 Electrical Metal, or Silectron . . . in standard tape thicknesses of 1, 2, 4 or 12-mils, and in ultra-thin gauges of ½ and ¼-mil where required.

Practically any size core can be supplied, from a fraction of a gram to hundreds of pounds. Toroidal cores are made in 22 standard sizes with protective nylon cases. Special sizes of toroidal cores, and all square or rectangular Tape Wound Cores, are manufactured to meet individual requirements.

Used for magnetic amplifiers, pulse transformers, current transformers, wide-band transformers, non-linear retard coils, peaking strips, reactors, etc., this gapless type of core construction results in maximum effective working permeability with minimum flux leakage.

## MOLY-PERMALLOY POWDER CORES



For use in loading coils, filters, broadband carrier systems and networks, for frequencies up to 200 kc, these Toroids provide high Q in a small volume, and are characterized by low eddy current and hysteresis losses.

Arnold Powder Cores are supplied in four standard permeabilities: 125, 60, 26 and 14 Mu. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc; the 60 Mu at 10 to 50 kc; the 26 Mu at 30 to 75 kc; and the 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability (±0.1%) over a specific temperature range.

These Moly Permalloy Powder Toroids are available in a wide range of sizes, to obtain nominal inductances as high as 281 mh/1000 turns. They are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

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Arnold manufactures permanent magnets from all grades of Alnico, although Alnico V is usually the preferred type due to the high value of energy product of that alloy. Alnico Magnets are quite hard and somewhat brittle and may be machined only by grinding. Most sizes and shapes are manufactured as sand castings and are made to the customer's drawings and specifications. Some types and shapes of Alnico Magnets are carried as stock items.

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# London Letter

RICHARD ARBIB*

AMERICAN "HI-FI" ENTHUSIASTS are apparently interested in British high fidelity equipment and have asked me for details of the models now on sale in England. I will deal briefly with them under three headings of record players, record changers, pick-ups, etc.; amplifiers; and loudspeakers.

Ever since 1927, when the first automatic gramophone (as we call them in England, and phonographs as you call them in America) was introduced by the British His Master's Voice Company there has been an ever increasing interest in the automatic method of changing records. Incidentally, most U.S.A. enthusiasts may not realise that the first mechanism for changing records automatically was designed for an acoustic gramophone and not for handling an electrical pick-up. This machine, introduced by His Master's Voice in 1927. performed many more operations than the average record changer of to-day. It played twenty records, which were stacked one on top of the other at one side of the machine. each individual record was lifted up. put on the turntable, played, and then rejected into a felt-lined box. It could also play one record individually, and the whole machine, even in the days of acoustic reproduction, could be operating from a pedestal up to 20 feet from the instrument itself. The only snag with this ingenious machine was that it was rather temperamental, and if it misbehaved it threw records right across the room instead of into the box.

Naturally, an instrument of this kind was not inexpensive to produce, and with the advent of the radio/phonograph combination the need was felt for a simple automatic record changing mechanism. One was developed again by H.M.V., and another one by Columbia, and then Garrard entered the field, and it was really due to their efforts that the majority of British radio manufacturers were able to produce inexpensive radio/gramophone combinations. The position at the moment is that H.M.V. have been rather eclipsed. In fact, at time of writing they do not offer a record changer of their own manufacture, and the one incorporated in their models is made for them by the giant Plessey Organisation, which is the largest British manufacturer of components. The record changer made by Plessey is just one of the thousand different lines they produce for

(*Continued on page 60*)

* *Multicore Solders Ltd., Hemel Hempstead, Herts., England.*

Mr. Alfred Lindley (right), assistant E.M.I. Record Press Room Foreman, is in direct charge of the presses turning out the new "Angel" series. Here he is with Charlie Knight, who pressed many of the early Angel discs back in 1909. Charlie is still with the company, after 44 years of service, and is now busily engaged in pressing the new Angel records.



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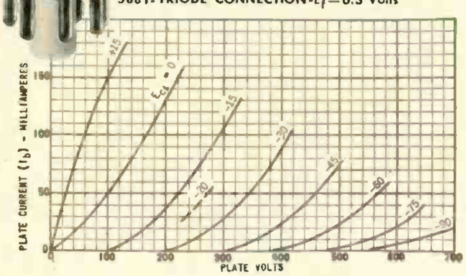


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|---|---|---|
| Heater Voltage | 6.3 | Volts |
| Heater Current | 0.9 | Amp. |
| Plate Voltage | 400 | Volts |
| Grid Voltage | −45 | Volts |
| Peak AF Grid to Grid Voltage | 90 | Volts |
| Zero-Signal Plate Current | 65 | Ma. |
| Maximum Signal Plate Current | 130 | Ma. |
| Load Resistance | 4000 | Ohms |
| Total Harmonic Distortion | 4.4 | Percent |
| Power Output | 13.3 | Watts |

**RATINGS** *(Interpreted According to RMA Standard M8-210)*

| | | |
|---|---|---|
| Heater Voltage | 6.3 | Volts |
| Maximum Heater-Cathode Voltage | 200 | Volts |
| Maximum Plate Voltage | 400 | Volts |
| Maximum Grid #2 Voltage | 400 | Volts |
| Maximum Plate Voltage (Triode Connection) | 400 | Volts |
| Maximum Plate Dissipation | 23 | Watts |
| Maximum Grid #2 Dissipation | 3 | Watts |
| Maximum Plate Dissipation (Triode Connection) | 26 | Watts |
| Maximum Grid Resistance (Fixed Bias) | 0.1 | Megohm |
| Maximum Grid Resistance (Self Bias) | 0.5 | Megohm |

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Tung-Sol produces the 5881 under laboratory conditions to insure peak efficiency and maximum uniformity. Order it from your regular supplier.

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# LETTERS

### American Diaphragm

SIR:

We have read with great interest the article, "Hi-Fi Sets of Yesteryear," by Charles L. Fallier, Jr., which appeared in your February issue. It was very gratifying to see the many references to Jensen high-fidelity loudspeakers which were manufactured in the middle and late '30's. The author's point concerning the excellent high-fidelity equipment available many years ago is well taken. Many new and glamorous names and products have appeared, created their following, and passed over the horizon. Many old ideas are reinvented and gain new followers.

For the record we would like to clarify one misstatement noticed in the article. The special 18-inch loudspeaker used with the McMurdo Silver Masterpiece V incorporated a composite diaphragm engineered in the Jensen laboratories; it was certainly *not* a British-designed cone. As a matter of fact, this loudspeaker was listed in our general catalog. Two versions were available: the Model HF-18 having a dural apex and the Model V-18 having a hard paper apex.

We are glad to observe that the high fidelity market has gained great impetus in this current upward swing and firmly believe that high fidelity is here to stay. Despite the excellent speakers and other equipment manufactured in the past, we recognize the merits of the current more extensive line and clearly see the need for further development.

KARL KRAMER
Manager of Tech. Services
Jensen Mfg. Co.
6601 S. Laramie Ave.,
Chicago 38, Ill.

### Cathode-Follower Input Impedance

SIR:

The article, "The New Golden-Ear Amplifier," by Joseph Marshall is of great interest to all who are interested in high-fidelity reproduction. The amplifier is well engineered; however, Mr. Marshall should exercise more care in his thinking about driving cathode followers with R-C networks. He states, ". . . the effective input resistance of the cathode follower is 10 times the grid resistor, or in this case 5 megohms. . . ."

With the circuit configuration shown (grid resistor returned to ground) the effective input resistance is the same as the actual value of the grid resistor. It would be some multiple of the grid resistor value only if the resistor were returned to some point on the cathode resistor and the grid were allowed to ride up and down with the cathode.

Mr. Marshall's use of cathode followers does cause the shunt capacitance from grid to cathode to be lowered by a sort of reversed Miller effect. This is desirable in that it lessens the diminution of highs. There is nothing, though, that would cause an increase in the effective R-C time constant of the coupling network. At 3.38 cps the response is down 3 db due to the coupling network, and the voltage on the grid of each cathode follower leads the voltage on the plate of the preceding tube by 45 deg. Mr. Marshall claims his coupling network has response down to about 2 cps before phase shift sets in. Actually, at 2 cps he has a leading phase angle of 59.4 deg. and response is down 5.88 db, or down to 26 per cent of the power at midfrequencies.

WILLIAM C. HOLM
919C Birch Road,
E. Lansing, Mich.

### Stereophonic Tests

SIR:

We are greatly interested in stereophonic sound since we broadcast two hours of stereophonic music and drama each week, using our AM-FM facilities. We have made a number of tests similar to those described by Dr. Goldmark in the October issue. We have found that unless great care is taken, the tests can be loaded to prove almost anything.

We have found that corner speakers give almost no stereophonic effect except for listeners at the focal point. Much better results usually come from placing both speakers against a wall as recommended by R. J. Tinkham. The dihedral placement suggested by Marvin Camras in 1947 is also valuable. Microphones must be placed properly too. We use three microphones, with the center one feeding equally to the two outside channels. A-B listening tests are invalid because of too many variables. We use 30-second segments of music for each technique variation.

JAMES CUNNINGHAM
National Broadcasting Co.
Merchandise Mart,
Chicago 54, Ill.



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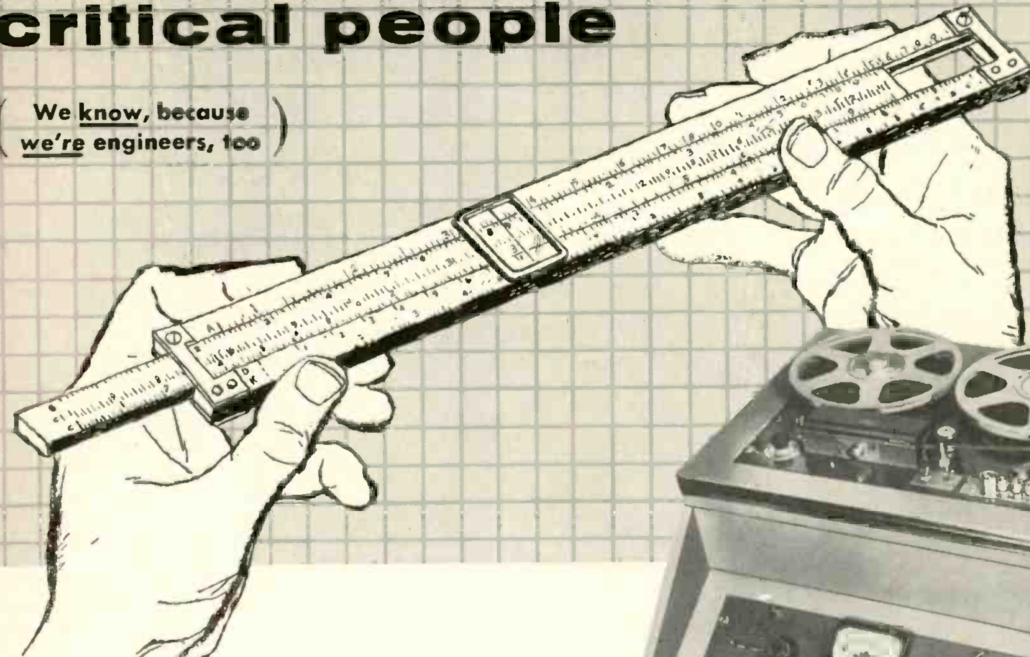
# engineers are critical people

( We know, because we're engineers, too )



Radio and TV stations, recording studios, commercial and industrial film studios, testing laboratories, program production organizations and a host of others have long needed a thoroughly professional, well designed, easily maintained tape recorder.

More than a year ago, Presto's top engineers were assigned to the development of such a recorder. Months later a test model was completed which not only met these specifications, but embodied a completely new principle of recorder design . . . unitized construction; the entire capstan drive is a separate, easily removed unit.

The instrument was designated "Model RC-11," and then a series of rigorous tests were begun. The RC-11 was run continuously for hours at a time under the most adverse conditions. These tests resulted in further improvements.

Finally, when we were satisfied that this was the finest tape recorder of its type that could be built, we tooled up and put it into production.

By reputation engineers are the most critical people on earth. (We know, because *we're* engineers, too.) And, some of the most qualified recording engineers who have seen and operated the RC-11 share one opinion . . . that here is the finest, easiest to operate, best performing tape recorder available today.

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- Three magnetic heads in metal enclosure.
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- Reel capacity to 10½" diameter.
- Response: 50 to 15,000 cycles ± 2 db.
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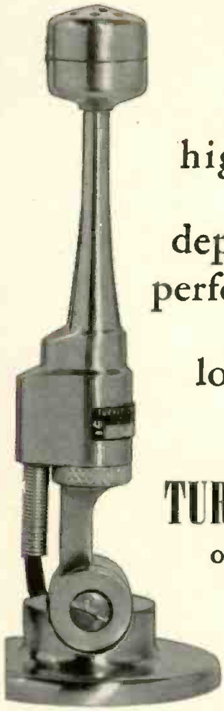

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dependable performance

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on C-4 stand

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For PA, home recorder, dictating machine, office and factory call systems and amateur uses, the Turner 80 performance is always dependable.

Sensitivity: Approx. 58 db below 1 volt/dyne/sq. cm.
Response: 80 to 7000 cps.
Weight: 5 oz. less cable.
Cable: 7 foot attached single conductor shielded.

C-4 stand gracefully matches the Turner 80. Both are satin-chrome plated. Stand won't tip or slide with weight of cord.

**Turner 80** list price_______$15.95

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# AUDIOLOGY

W. R. AYRES*

## Transient Response of Audio Amplifiers

When either speech or music is to be reproduced, the amplified and transduced signals are of highly transient nature, and quite different from continuous signals with which simple testing can be performed. An entirely satisfactory procedure, closely enough correlated with listening data to warrant numerical specification, is not yet forthcoming. Qualitative terms like "clean," "rough," "crisp," "muddy," etc., will perhaps be in conversational use for a long time to come. However, there are several useful sets of information, relating to transient response, from which important amplifier requirements may be deduced. These relate to the nature of hearing itself, some considerations of instantaneous peak-handling capability, and momentary overload effects due to large signals suddenly applied.

### Amplifier Amplitude and Phase Response

To reproduce a complex waveform faithfully, all important frequency components must be similarly amplified, and delayed by the same time interval. It is by no means necessary that phase shift be zero at all frequencies, but simply that phase shift be directly proportional to frequency. As plotted on linear graph paper, phase shift *vs.* frequency over the useful frequency range preferably lies along a straight line which passes through the origin, or through some multiple of 180 deg. When R-C and/or transformer coupling is used, output customarily lags in phase at high frequencies and leads at low frequencies.

Obviously at low frequencies the phase response curve must ultimately depart from linearity, unless direct coupling is used throughout. In commercially successful audio power amplifiers, direct coupling usually amounts to eliminating coupling capacitors between (say) two of possibly four stages, with the output transformer untouched; thus only minor improvement can be expected for rather expensive efforts.

In a broad class of transmission circuits known as minimum-phase-shift networks, of which commonly used amplifiers are representative, amplitude and phase characteristics are related in such a way that establishment of one sets the other. Low phase shift occurs automatically in the frequency range of flat response, and so has no independently useful significance. Clearly then, if the frequency response of a linear amplifier is uniform (say within a db or so) throughout the audio frequency range, then the phase distortion is low as a natural consequence, and the transient response is far beyond audible reproach.

### Amplifier Nonlinearity

A much greater offender is nonlinearity, at which all amplifiers fail to some extent. Particularly through use of negative feedback and good components, the linearity of a modern high-fidelity amplifier in terms of intermodulation distortion can be held to a small fraction of one per cent up to within a few db of normal rated output. That same negative feedback reduces the amplifier output impedance, with generally desirable effect upon electrical speaker resonances; however, there appears to be no trick of amplifier design which can materially affect the many large and steep response variations caused by the cone mounting, speaker enclosure, and listening room acoustics.

Nonlinearity represented by even momentary overload during transient peaks can sound very objectionable. Obviously, with recorded material, as from disc or sound-on-film, there is little need for 10 db power capability over that represented by full modulation, since excess peaks have already been suppressed. With live program material not previously clipped, peaks may be reproduced if greatest fidelity is sought, but only with power capability considerably in excess of normal volume requirements.

### The Hearing of Complex Sounds

The hearing process involves selective excitation, according to frequency, of thousands of separate nerve fibers leading from the ear cochlea to the brain. Tests have shown that this amazing equipment divides the audio-frequency range into roughly 1400 just-detectable changes in pitch, with acuity greatest at mid-frequencies.[1] For example, in the frequency range from 1000 to 2000 cps, there are well over 200 perceptible changes in pitch, while the equally tempered musical scale has only 12 tones in this range. Since in effect sound at each frequency is detected with separate apparatus each receiving separate recognition by the brain, we can, incidentally, more readily understand the occasional development of the novel accomplishment known as absolute pitch.

The cochlea portion of the ear is not only the frequency selective mechanism, but a sort of sound analyzer as well. When a particular portion is excited by the characteristic frequency thereof, the signal transmitted by the appropriate nerve fiber to the brain is not a continuous wave of selected sound, but simply a series of impulses at rate depending upon the intensity of the sound component heard. There being no apparent means by which the phase relation between (say) harmonically related tones can be transmitted to the brain (without being obliterated by the effects of their relative amplitudes), a reasonable conclusion has resulted that phase shift alone cannot be heard.

But more correctly, since phase shift rep-

* *RCA Victor Div., Camden, N. J.*

[1] H. F. Olson, "Musical Engineering," McGraw-Hill 1952, p. 249.



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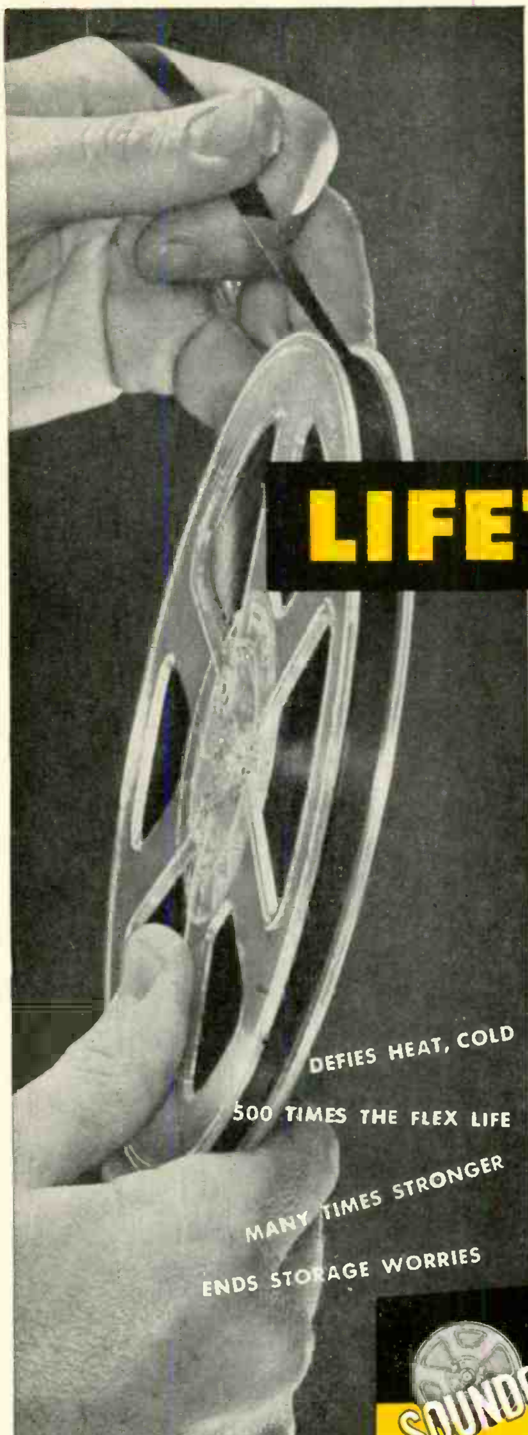


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*It will last, to the best of engineering knowledge, forever!**

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All this means that for the first time you can preserve your important recordings, capture and keep those precious moments of music and the spoken word, for generations to come—in all their original fidelity!

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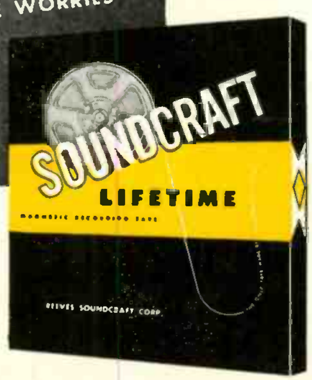


Like all Soundcraft magnetic products, LIFETIME Tape is Micro-Polished®, assuring maximum high-frequency response. It provides uniformity of ±¼ db. within a reel, and ±½ db. reel-to-reel. It is splice-free in 600-, 1200- and 2400-foot reels.

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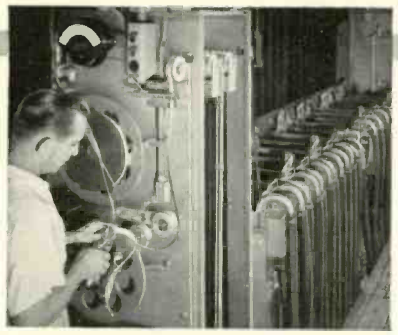

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resents time difference, then if the phase shift is great enough (perhaps many cycles), different frequency components may be heard at distictly different times. Naturally then the signal would "sound different." This is quite close to what actually happens, and when considering transient waveforms, a viewpoint preferable to one of phase shift is that of permissible variation in time delay in the reproduction of various frequency components represented in the complex waveform. Logically, the time delay of various reproduced components should vary materially less than the 10 to 15 millisecond average sampling time required for the establishment of pitch consciousness. Using 1000 cps as convenient reference, and 1 millisecond as permissible delay variation, the permissible phase shift would be 36 deg. at 100 cps, and 3600 deg. (10 whole cycles) at 10,000 cps. According to measurement,[2] in the 5000 to 8000-cps range, the time delay could be as much as 10 milliseconds different from the 1000-cps value, and at 50 cps that time delay difference could be as much as 75 milliseconds, without noticeably affecting the quality of reproduction. The phase shift amounting to such time delay is obviously enormous compared with the characteristics of ordinary amplifiers. In fact, if one set out to produce either of the quoted conditions, considerable effort and apparatus would be required.

### Power-Supply Transient Dip

When true Class A amplification is used in the power stage, the average plate current is constant from no signal to maximum undistorted power output. But with more efficient classes of operation now almost universally employed, average plate current to the output stage changes markedly when signal is applied, often being twice as much (or more) at rated power output as when no signal is applied.

An occasionally troublesome characteristic of conventional rectifier filter circuits is the transient fluctuation in output voltage with sudden changes in load current. With large additional load suddenly applied to the power supply, the voltage may momentarily fall to a materially lower value than its final steady value at the new load current. When the load is suddenly lessened (i. e., less current drawn), the voltage momentarily jumps to a higher value than its final steady value, and particularly in this case the voltage may periodically fluctuate ("ring") in damped fashion at a rate depending upon the filter inductance and capacitance.

The fractional dip in supply voltage is given approximately by the relation:[3]

$$\Delta e_B = \sqrt{L/C}\,/R_L \qquad (1)$$

where $L$ is the series inductance in henrys, $C$ is the shunt capacitance in farads, and and $R_L$ is the partial load producing the change in output current. For example, if the load on a 300-volt supply increases 100 ma when full signal is applied, the partial $R_L$ is 3000 ohms. With $L$ and $C$ of 8 henrys and 8 microfarads, respectively, the fractional transient dip is:

$$\Delta e_B = \sqrt{8/8 \times 10^{-6}}\,/3000 = 1/3 \qquad (2)$$

Momentarily the 300 volts dips to only

(*Continued on page 47*)

[2] Research Council, Academy of Motion Picture Arts and Sciences, "Motion Picture Sound Engineering," D. Van Nostrand Company 1938, p. 191.

[3] Reuben Lee, "Electronic Transformers and Circuits," Wiley 1947, p. 102.



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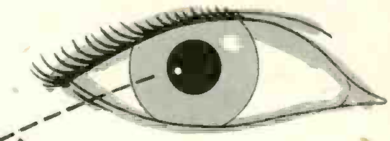
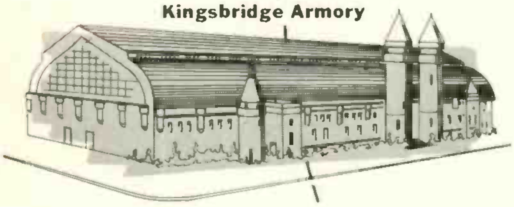
# *The eye-opening event of the radio-electronic new year!*




For the past 12 months the vast, fast-growing radio-electronic industry has been preparing for 4 great days — March 22-25. This is when the IRE National Convention and Radio Engineering Show — the biggest and best ever — will take place in New York City. Be sure to join the other radio-electronic men — nearly 40,000 are expected — who will come, see and appraise the show at which all that is new will be unveiled.

A practical summary of radio-electronic progress will be unfolded at 54 technical sessions during the four-day period. 243 scientific and engineering papers, grouped by related interests, will be presented during these sessions, more than half of which are organized by IRE professional groups. Actually, you will be attending 21 conventions fused into one. New York's finest meeting facilities are provided — the Waldorf Astoria Hotel plus 3 huge halls in Kingsbridge Armory. Transportation between the two locations is quick, easy — by subway and bus service.

At the show you will find over 600 firms **"spotlighting the new"** in their high-interest product exhibits. These will extend over a mile and a half along avenues appropriately named for radio elements: "Instruments," "Components," "Airborne," "Radar," "Transistor," "Audio," "Microwave," etc. These exhibits, an education and revelation in themselves, fill the four-acre space of the great Kingsbridge Armory . . . and can be viewed throughout any one or all of the four days.

Admission is by registration only, and serves for the four-day period. For IRE members the cost is only $1.00. For non-members it is a low $3.00, covering sessions and exhibits. Social events have been carefully planned. These are priced separately.

## *March 22-25, 1954*

**is the date! New York is the city where the radio-electronic event of the year will take place. Come! See! Enjoy!**


THE 1954
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# EDITOR'S REPORT

## AUDIO FAIR—LOS ANGELES

At the conclusion of each assemblage of the public, the hi-fi fans, and those music lovers who are just desirous of hearing their music properly reproduced, it becomes the duty of this reporter to review the event, cite the unusual in displays, and credit those to whom credit is due. In the reverse order, let us first award an editorial orchid for the fine work displayed by the Los Angeles Section of the Audio Engineering Society in preparing the aspects of the show designed to educate the visitors. Under the direction of John T. Mullin, who was the first Western vice-president of the Society, a series of slides was prepared to go with a tape-recorded description of hi-fi which would be thoroughly understandable to a complete stranger to the word (if there are any such left). The story centered around a visitor from outer space who drops into the Fair to learn about hi-fi. Since the whimsical little character was named $\psi$ and was, in addition somewhat bashful about attendance at a function peopled predominantly by Earth folk, and since this character became acquainted with our own art, the show was titled "Shy Si Meets Hi Fi." This twenty-minute tape, accompanied by the colored slides, told what the visitor could expect, why the hi-fi industry existed, what hi-fi equipment would do, and what it had to do to make music approach the original. Beside doing a good job, it was also entertaining, and everyone came away pleased. The feature was repeated every half hour, and there was always a line waiting for the doors to open.

Further credit is due the Los Angeles group for the establishment of an active industry advisory committee to work with the Fair officials and the officers of the Societey to smooth out operating procedures. The entire show ran with the efficiency engendered by such coordination, and the Society took a large part in the preliminary work and in the publicity—which was well done and which covered the area quite thoroughly.

The weather took its cue from the event and was Fair throughout the three days. The sun shone and there was no smog, no fog, no rain, and—to the gratification of the Easterners who attended—no snow. But so it was in 1953. Apparently what we have heard about California weather is true. Attendance at an Audio Fair for three days cannot be called a vacation by any stretch of the imagination, but the weather was perfect for one.

Exhibits were complete and were, in general, conducted in better taste than heretofore at Audio Fairs—which means that demonstrations were put on in room after room at reasonable sound levels and with considerably less disturbance to adjacent rooms than has been noticed on some previous occasions. The typical Audio Fair "curve"—up 20 db at 50 and 12,000 cps—seems to have disappeared and music is now being reproduced as music rather than as a fugue for tweeter and woofer.

The Society presented a total of nineteen technical papers covering transducers, amplifiers and equipment, applications, various aspects of recording, and new developments. All the sessions were well attended, and the full texts will be available in due time in the *Journal of the Audio Engineering Society.*

Audio Fairs have many advantages—not the least of which is the opportunity they provide for the manufacturers and consumers to exchange ideas about products. And this opportunity extends to manufacturers of magazines as well as to manufacturers of audio equipment. The ideas that come to us from our readers at these gatherings are of real importance to us, for they help us to direct our efforts toward "building" the kind of magazine which will be of greatest value to readers. We take this opportunity to thank everyone who took the time and trouble to talk to us and to make suggestions for our guidance. We like to think these readers are our friends, and we always look forward to the next opportunity of getting together.

## AUDIO SOCIETIES

There are a number of active organizations in the audio field which are not of an engineering nature. One of the most active of these is the Louisville (Ky.) Audio Society which recently announced a series of special meetings designed for those who want to learn more about audio techniques and technology. And the new four-page bulletin is meticulously done in hand lettering and offset (we should guess) and contain some well prepared material. In fact, we should even like to reproduce some of it for all of our readers.

While the members of the LAS apparently have some interest in technical matters, their principal interest seems to be in the music. We particularly liked a little box on the first page of the January *Bulletin* which stated: "We like music, too! Anyone interested in getting together to listen to the *music* and not particularly the *fidelity* will find. . . ." Well put, we think, for the real value of high-quality audio equipment lies not in the "fidelity"—which all too often suffers from ill-advised settings of the controls—but in the pleasure which can be had from good music properly reproduced. The Louisville Audio Society might well serve as the model for others to follow in forwarding the trend toward better audio.

## RED FACE DEPARTMENT

In reviewing "Musical Gadgetry, (vol. 1)" in his February column, Mr. Canby credited Weathers industries with the recording, whereas the actual fact is that the lacquer mastering was done by the Van Levis Recording Studio of Philadelphia. Paul Weathers designed and built the Weathers Cutterhead System which is used in making Van Levis' SPECTRUMAX lacquer masters. Furthermore, the Weathers pickup is used in checking the recordings at the studio.

This is mainly a case of not reading the fine print, but for Mr. Canby our face is red. And we are pleased to render unto Van Levis the things which are Van Levis'.

*(Continued on next page)*



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Quality is an elusive thing. Engineers measure it . . . copywriters glorify it . . . salesmen describe it. But the final test is actual performance. If a product is the best in its field, those who know quality will accept no other.

That is the story of Pickering's new 260 Turnover Cartridge.

Introduced only months ago, it is already a leader among magnetic cartridges. It has won that position because it is the nearest thing to perfection yet produced. Here are the combined advantages it offers:

# The nearest Thing to Perfection


A simple flip of the handy lever and you're ready to play any favorite that fits your mood—whether it's standard or microgroove.

1. HIGHER OUTPUT—*Better overall signal-to-noise ratio.*
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3. MINIMUM TRACKING FORCE —*Lowest practical tracking force for both microgroove and standard recordings.*
4. HIGHER COMPLIANCE—*Compliance of moving elements is the highest practical, consistent with best-quality transcription arms and changers.*
5. LOWER MOVING MASS —*Lowest of any comparable magnetic cartridge.*
6. TWO DIAMOND STYLI—*For longer record and stylus life and greatest economy.*

These design features have real meaning to those who understand that quality reproduction depends on components which meet professional standards. If you want the best that high fidelity can offer, ask your dealer to demonstrate the new 260 Turnover Cartridge. You, too, will hear the difference!

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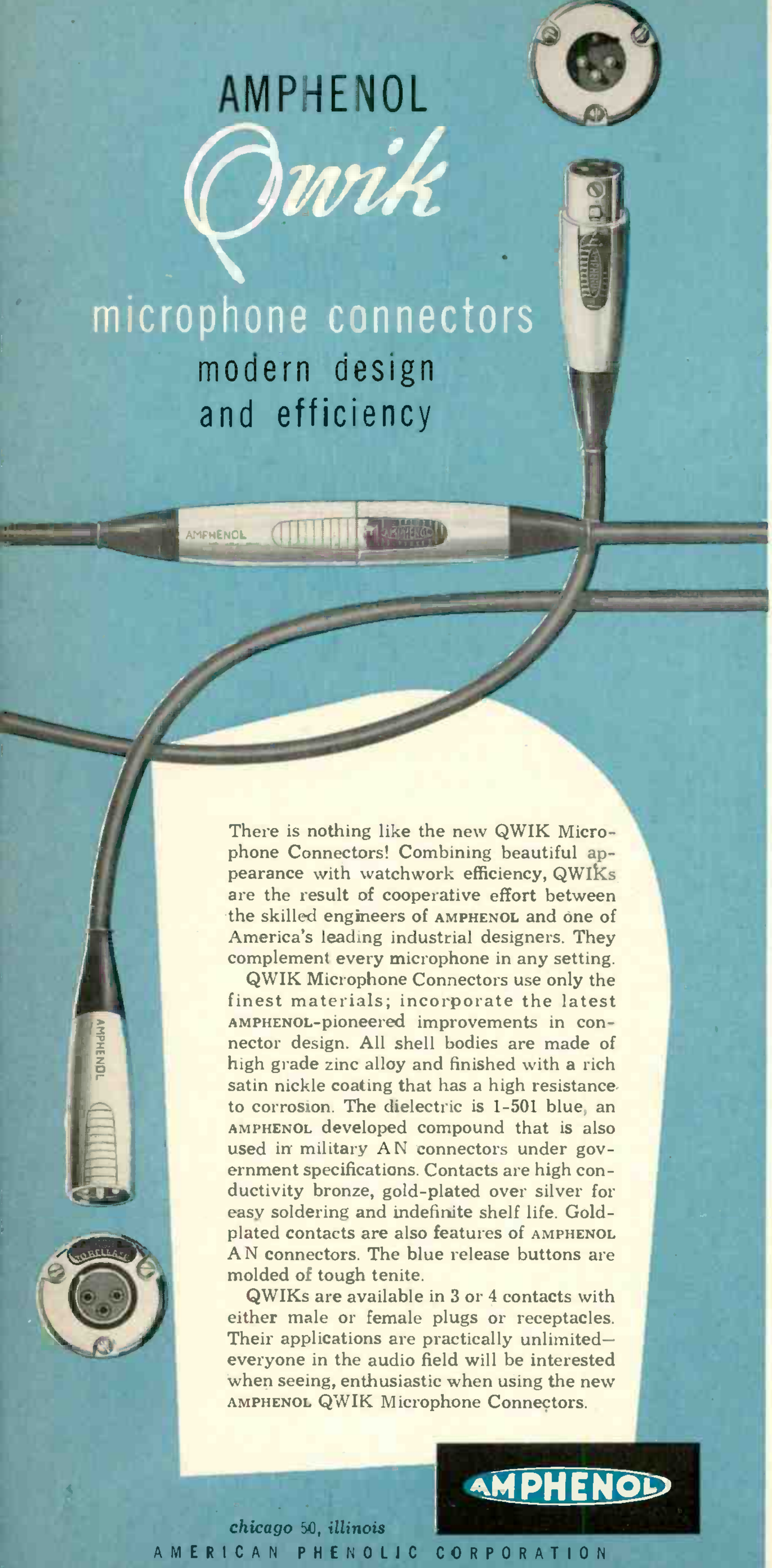


## EDITOR'S REPORT (Cont'd)

### WASHINGTON (D.C.) FAIR

The next event on the audio calendar seems to be the High Fidelity Fair in Washington, D. C. This exhibit will be held at Hotel Harrington on March 5, 6, and 7, and is produced with the cooperation of the Washington Audio Society and WGMS, Washington's Good Music Station. The event is being exceptionally well publicized, and we are curious to see how big a turnout the first show in the nation's capitol will rack up.

Among the serious aspects of the event is an address by FCC Commissioner George F. Sterling in the auditorium of the Perpetual Building and Loan Association on the evening of the 5th. This talk will initiate a series of meetings and lectures throughout the three days. A concert from the Library of Congress on the first evening will be the first public Washington demonstration of the Crosby Multiplex System of FM broadcasting—a scheme which allows two signals to be sent from one transmitter at the same time. Thus the boardcast will be a demonstration of a practical method of disseminating a stereophonic program.

As usual, we will be represented—partially to see the result of the Hi-Fi Fair's contest to choose the girl with the most beautiful ears.

### TRIVIA FROM THE LA FAIR

Most amazing sight—an attractive model from the display of Penny-Owsley Music Co. standing alongside a large and loud speaker in High-Fidelity House's display room just daring them to make it too loud for her to enjoy—and she was smiling all the time. Second candidate for most amazing sight—blasé New Yorkers hieing to Billy Gray's Band Box two or three nights in a row to see and hear Joe Lessy and others in a riotous show.

We thought we'd been discovered by a fan at LA's famous Biltmore Hotel. We returned to the hotel one night to find a large basket of fruit—complete with cellophane bows—and naturally assumed that the manager and assistant manager, whose cards accompanied the basket, were audio hobbyists or at least readers. Denouement came when we compared notes with Henry Gage, Westminster Records prexy, who was similarly favored. This must be true California Hospitality.

Or do you suppose those two gentlemen really do like good music well reproduced?

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**Listening Quality*

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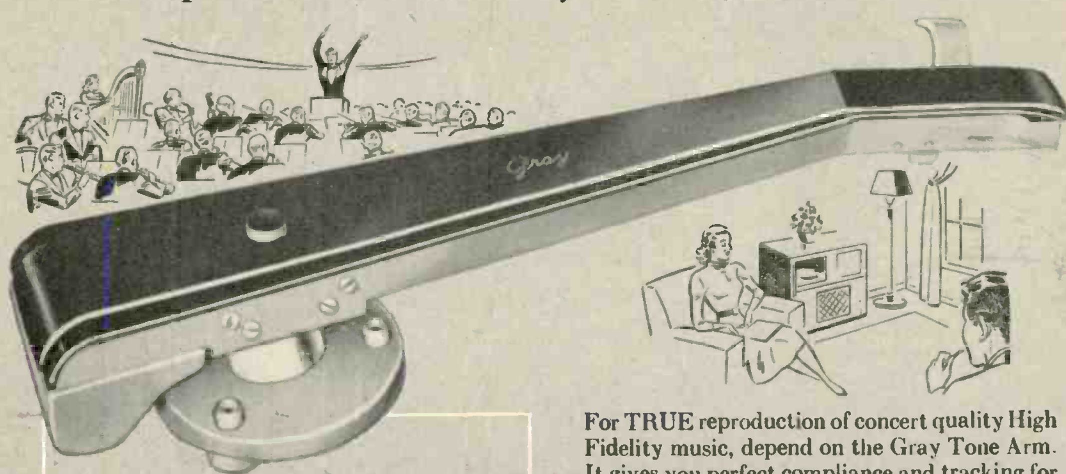


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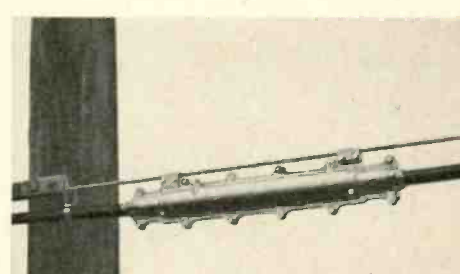

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# Problems Involved in Magnetic Tape Recording*

NORMAN E. GIBBS†

**Results of a program of research into defects of magnetic tape and their applications to pulse reproduction when tape recorders are used as computer memory elements.**

MAGNETIC RECORDING PROCESSES are rapidly being applied in many phases of scientific research, industrial measurement and control, as well as for storage of information in large-scale computers. In many of these applications it is essential that the pulsed data recorded be completely and accurately recovered.

A number of factors affect the accuracy of the storage processes. Chief among these are the design features of the tape-handling mechanism including recording heads, the characteristics and stability of the magnetic medium, and the reliability of associated circuitry.

It is the purpose of this paper to examine in particular the contribution of the medium itself, especially currently available tapes, to the over-all reliability of the magnetic recording process. Heretofore, chief attention in most applications has been focused upon design of equipment, and the currently "best available" tapes have been utilized.

In observing the cathode-ray patterns produced during playback of a continuous train of pulses from a magnetic tape, it has often been noted that the amplitude of some of the pulses became quite small or practically disappeared from the otherwise nearly constant signal envelope. These apparent losses of pulses have been termed "pulse drop-outs." A program of investigation which has been pursued at Raytheon for nearly two years is summarized in the following brief outline of the causes and effects of "drop-outs."

Continued research has established conclusively that the causes of drop-outs are (a) defects inherent in the tape itself, (b) foreign matter, such as dust, temporarily on the tape surface, and (c) mechanical flutter in tape drive and accumulation of static charge.

### Inherent Tape Defects

At the start of the investigations, the high-power microscope revealed that the surface of the magnetic tape contained zones varying in color which departed from the usual flat and smooth texture.

Before examining the causes of these abnormal areas, consideration of the construction of a typical tape lends perspective. In general, a thin film of magnetic material approximately .00025 to .0004 inch in thickness is deposited upon a cellulose acetate base which is itself only about .002 inch thick. Fabrication is complicated by several factors. The magnetic particles must be sub-micron size in order to provide favorable magnetic properties. Colloidal suspensions of these minute particles must be utilized, and contamination by traces of impurities or dust may cause flocculation of particles at local zones, resulting in lumps of adhering material. It is imperative that filters and agitators be used, that all ingredients be checked as to purity, and a high degree of cleanliness maintained in all operations.

Traces of impurities, dust, or vapor, may affect the surface tension of bonding agents, causing pin-holes where surfaces were not perfectly wetted. Great precautions must be taken during drying operations to avoid dust falling on the still tacky surface of the tape. Yet the over-all thickness of the applied layer must be maintained within close limits or response characteristics will suffer. Fabrication of good tapes is not an easy task.

It was found that defective areas in tapes were due chiefly to:

1. Particles of metal or other foreign matter embedded in the tape surface.
2. Bubbles formed during the drying of the tape which left a ring of magnetic material in the center of which the film had collapsed and dried in folds and crevices.
3. Pin-holes in the magnetic layer, easily visible by holding the tape up to a light source.
4. Droplets of magnetic material were rolled out over the tape and attached stickily to the magnetic layer like chewing gum on a floor.
5. Smaller particles of magnetic material, evidently not very tacky since a few passes of tape under the heads wipes them free.
6. Clumps, formed by a process of which the exact nature is unknown, but which entails the apparent growth of the clump at the expense of the magnetic material in the surrounding area.
7. Areas in which the bonding agent had failed to keep magnetic layer intact and the latter had flaked off.
8. Imperfections in the acetate base such as wrinkles and roughness somewhat resembling orange-peel in appearance.

It has been gratifying to find during the course of time that the tape manufacturers have succeeded largely in eliminating many of these causes of defects. Tapes are now much cleaner and are minus the metal particles, "globs" resembling gum, and usually the pin-holes.

The sketch of *Fig.* 1 shows a cross section of the chief offender remaining unconquered. The zone surrounding a clump is marked by its rough appearance. Apparently clumps are formed after the magnetic material has been applied to the tape and is still in a moist condition. Some factor causes adherence of the particles in this local zone to form a clump while sufficient migration of others in the suspension causes the recession in the surface level in the surrounding area.

With elimination of metal particles embedded during tape fabrication, dust and dirt constitute the chief sources of foreign material on tape surfaces. Magnetic mud, consisting of small particles sloughed off the tape and mixed with minute particles of core material and dust, frequently becomes rolled into small lumps which stick to the tape. Elimination of all of these is highly desirable.

Mechanical flutter of the tape as it passes under the heads results in variation of contact between tape and head surfaces which produces serious shifts in signal amplitude if not actual loss of information. These variations in signal level are due to the additional gap be-

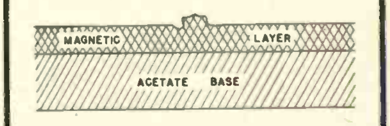


Fig. 1. Cross-section of a clump, showing the effect on the surface of the tape.

*From a paper delivered at the Symposium on Electronic Computers, sponsored by the Los Angeles Professional Group on Electronic Computers, University of California, April 30th, May 1st, 1952. Reproduced by permission from the *Symposium Proceedings.*

† *Computer Equipment Section, Raytheon Mfg. Co., Waltham, Mass.*



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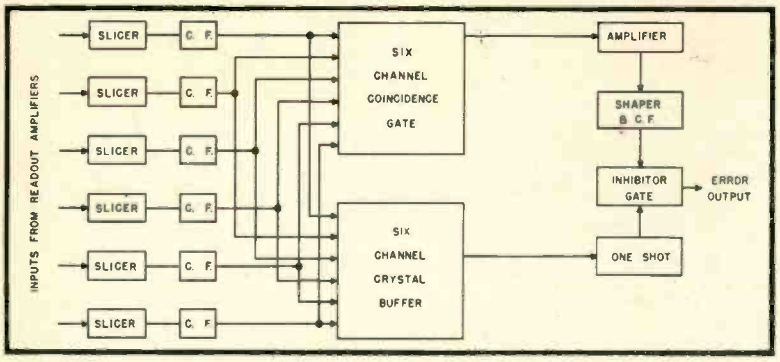


Fig. 2. Block diagram of the 6-channel coincidence circuit used in the investigations.

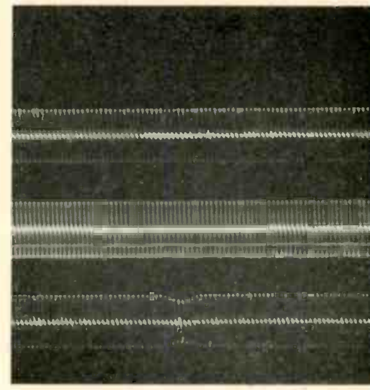

Fig. 3. Photograph of recovered pulses as they appear on an oscilloscope shows a typical minor defect appearing on tape using permanent magnetic bias.

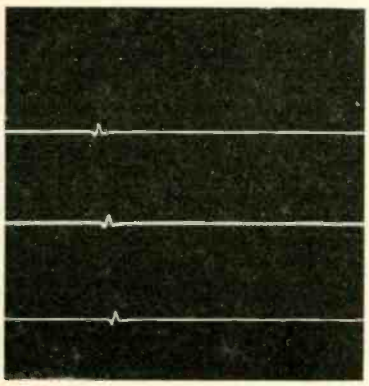

Fig. 7. Playback of tape with butted splice shows this pattern after permanent-magnet erasure.

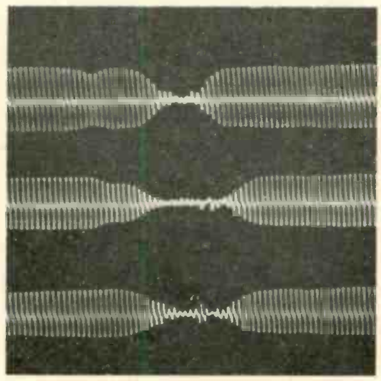

Fig. 8. Playback of writing over a lapped patch.

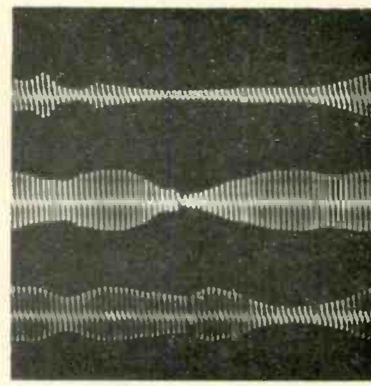

Fig. 9. This is the result of an attempt to cut and splice tape containing a continuous train of pulses.

tween the head and the magnetic surface.

All of these losses may not be due to the tape mechanism, however, since wrinkles in the tape, scalloped edges, etc., may cause similar effects. Stretching in local zones may cause curling of the tape and hence a variation in tension as these zones travel under the head. Attention must be paid at all stages of handling tapes to factors such as alignment of guides and idlers, use of proper tension in rewinding, and so on, to avoid these difficulties.

In rooms where the relative humidity is quite low the tape may acquire a static charge. Unless this is dissipated it may cause undesirable transients in playback circuits and every vary the tape tension due to adherence of adjacent layers of tape.

Having ascertained that defects existed in the magnetic medium which probably were responsible for pulse drop-outs, several problems remained. Methods of detecting tape defects had to be devised in order to determine the number of defects per roll of tape and reality of correlation between defects counted and presence of actual bad areas on the tape. As a defect passes under the playback heads actual effects taking place had to be determined. What could be done with tapes containing defects to make them usable in computer service?

#### Methods of Detecting and Counting Defects

Microscopic inspection of tapes would be difficult to achieve. With illumination at a grazing angle, however, microscopic studies were valuable in establishing size and contour of clumps.

Observations of cathode-ray patterns are informative but it is usually difficult to stop the tape upon sighting a drop-out. High-speed photography of multi-channel patterns appearing simultaneously on cathode-ray tubes is highly effective in establishing the effects produced by clumps.

Comparison bridge circuits proved promising when checking playback signals from two channels in which continuous trains of pulses had been written.

The most satisfactory unit, however, was designed to permit simultaneous examination of all six channels on the tape. As shown in the block diagram, *Fig*. 2, the playback signals from the six-channel preamplifiers are fed through slicers and cathode followers. A steady stream of pulses reaches the six-channel coincidence gate simultaneously from all channels. As long as this condition exists, these pulses are fed through the amplifier, shaper, and cathode-follower to the inhibitor gate.

Meanwhile, however, pulses have been fed simultaneously to the six-channel crystal buffer causing operation of the one-shot. The output of the latter is led to the other side of the inhibitor gate. A positive pulse is emitted by the latter only when a pulse is missed in one or more of the channels. Controls can be set so that if the amplitude of the playback voltage for one or more pulses drops below 50 per cent of average value, a count results, hence the threshold is set at 50 per cent. The threshold may be varied. An electromagnetic counter can be tripped by the pulse from the inhibitor gate.

A more convenient arrangement is to use this pulse to stop a Raytheon Tape Mechanism involving a tape travel of about 3/16 in. so that the area of the tape immediately under the playback head may be carefully inspected.

This detector, with requisite precautions, yielded consistent counts on repeat runs of the same reel of tape.

#### Test Procedures and Results

Test procedures were as follows:

1. A tape was cleaned of dust by wiping it with a lens tissue pad during writing and playback operations.
2. Using the coincidence detector, the number of defects in a given length of tape was determined for all six channels.
3. This section of tape was then played back and the cathode-ray patterns of three channels were photographed simultaneously with a high-speed camera. A repeat run provided data on the remaining three channels.



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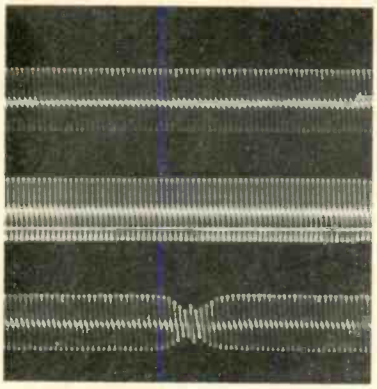

Fig. 4. A serious defect on tape with permanent-magnet bias. Note the trend to partial center recovery.

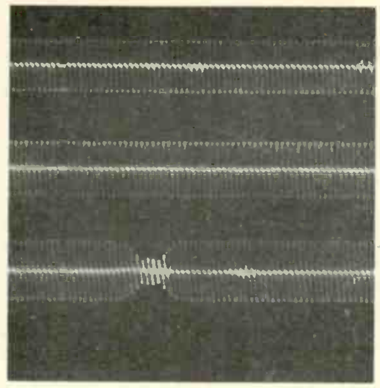

Fig. 5. A serious defect without any center recovery.

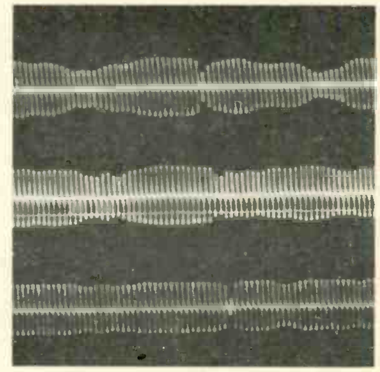

Fig. 6. This oscillogram shows the effect of writing over a butted splice on magnetically neutral tape.

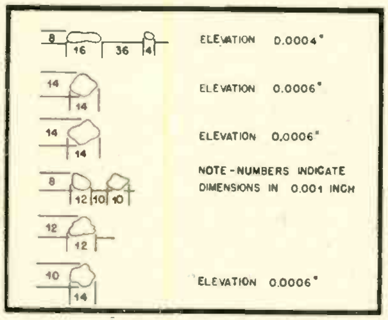


Fig. 10. These were among the defects manually removed from the tape. The drawings show the general shapes and sizes. Dimensions are given in thousandths of an inch.

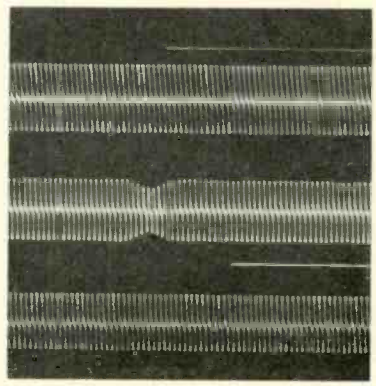

Fig. 11. After removal of defects from the tape, this pattern is indicative of about the worst remaining fault.

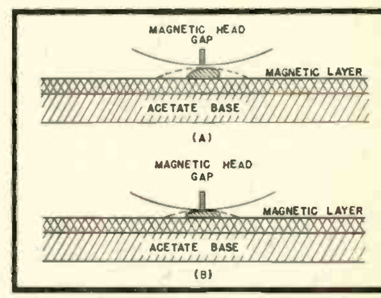


Fig. 12. The action of the tape and head when a defect appears. In A a condition like that of Fig. 5 is produced. In B some center recovery is possible, as in Fig. 4.

4. The tape was erased, then rewritten.
5. Recounts were made on the coincidence detector, which checked with originals.

*Figure* 3 shows the effect produced by a typical minor defect. About a half dozen pulses are affected. Pulse density is 100 per inch in all the illustrations. Counting pulses therefore gives an idea of the area affected by the tape defect.

In *Fig*. 4 can be seen the typical effect produced by an average clump. *Figure* 5 shows a somewhat different effect caused by a clump in which no center recovery occurs.

Since a patch in the tape introduces a defect, some photographs were made of these also. *Figure* 6 shows the effects caused by a typical butted splice held by splicing tape and *Fig*. 7 shows the effect produced by the same splice when tape was erased with a permanent magnet.

A lapped patch causes greater disturbance of patterns as shown in *Fig*. 8. *Figure* 9 shows the effect produced by attempting to cut and splice a tape bearing a continuously recorded train of pulses.

It is apparent in many of the photographs that practically no variation of signal amplitude occurs except at areas of defects. This indicates that mechanical flutter effects are quite small. Some effects could be observed in the case of the patches.

Using the techniques described, it was possible to examine small local areas, rather precisely located by the stopping of the tape drive, for defects. In nearly every case where the drive was stopped due to action of the coincidence detector a defect was found by microscopic examination.

*Figure* 10 shows the general shape and gives measurements for six typical defective areas. Elevation of the clumps was measured also. Some of the photographs correspond to these defects.

In some cases no defect was found on the tape. In the huge majority of these, however, a small dust particle or bit of lint was found adhering to the tape.

At the marked locations of the errors removal operations were attempted to determine whether unmarred magnetic material lay below most of the clumps. By very dextrous and delicate use of small scalpels under a microscope it was found possible to scrape away all of these defects leaving a relatively unmarred, normal surface of the tape. In removing one such defect an actual pit was dug through the magnetic layer. This was dexterously filled with some of the material removed. Utmost cleanliness and care were used during these processes.

The tape was now erased, rewritten and passed through the coincidence detector. The area of tape formerly giving a count of 7 now gave a count of 1. A pattern of one of the worst effects on this section of tape now appears in *Fig. 11*. Effects are much less than the approximate 50 per cent shift in level formerly obtained.

#### Mechanics of a Drop-out

*Figure* 12 portrays the mechanical lifting of the head away from intimate contact with the tape surface under two conditions. In B center recovery is possible since the center flat portion of the "glob" permits laying down of at least one magnet.

R. L. Wallace Jr. of the Bell Laboratories has made experimental determinations of the spacing losses involved when a playback head loses contact with the magnetic surface. As reported in the October, 1951, issue of the *Bell System Technical Journal,* this loss corresponds in db to 55 times the ratio of the separation distance to the wavelength of the magnets involved.

The elevation of clumps was found to be about .0006 in., as shown in *Fig*. 10, and the wavelength of the magnets is close to .005 inch giving a ratio of .012. Fifty-five times this ratio gives a figure of 6.6 db as the separation loss. This agrees closely with the operation of the detection circuit and the photographic data.

(*Continued on page 52*)



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# Planning Your Home Music Installation*

IRVING GREENE** and JAMES R. RADCLIFFE***

**In Two Parts—Part 2**

**The facilities offered and the appearance of the finished installation are limited only by the imagination of the person doing the planning—just decide what you want and how it should look, then go ahead.**

PREPARATION OF A THOROUGH PLAN for a high-fidelity installation is a simple, commonsense project which ensures satisfaction and eliminates any possibility of disrupting room decor. Of greater importance is the fact that it prevents the possibility of added and unwarranted expenditures for redoing a piece of furniture or unloading, at a loss, a tuner or amplifier that proved to be an incorrect choice.

Years back, when Radio was only within the reach of the technically informed experimenter, breadboard[1] circuits were arranged atop the dining room buffet or table amid a maze of wires and batteries. Consoles or cabinets were unheard of and yet to come. But, the thrill and wonder of this electronic phenomenon obviated any woman's desire for orderly and decorative cabinetry for science's last contribution to gracious living. Today, the same awesome respect for electronic gadgetry is still exhibited by the average American Housewife *provided* it is attractively packaged and will not mar the beauty and decor of her home. Almost without exception, the average woman of the house will *veto* any plan which involves one or more "naked" chassis cluttering the top of any article of furniture in the home.

The problem is always ". . . well, now that we have decided on a group of components for our music system . . . where shall we install it?" To select equipment without giv-

* Excerpted from the book "THE HIGH FIDELITY HANDBOOK" by Irving Greene and James R. Radcliffe, to be published by Crown Publishers, Inc. in the Fall of 1954.
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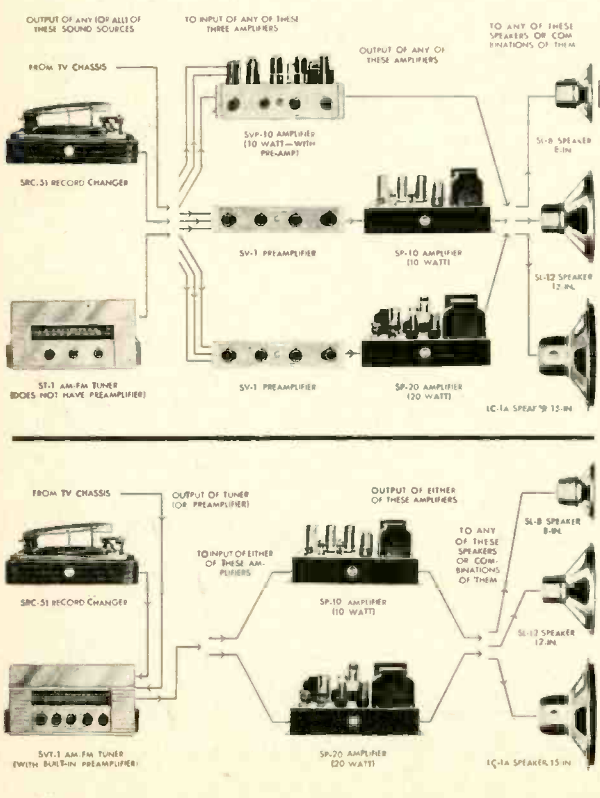
** *17–49 166th Street, Whitestone 57, New York.*
*** *170 Twin Lane North, Wantagh, New York.*

[1] The term "broadboard" derived from the square or rectangular wood base on which experimenters constructed and wired their "receivers" during the late 1920's and early 1930's. It was so named because it resembled the breadboard Mother used to use, and in fact, often was one which had been liberated from the kitchen.



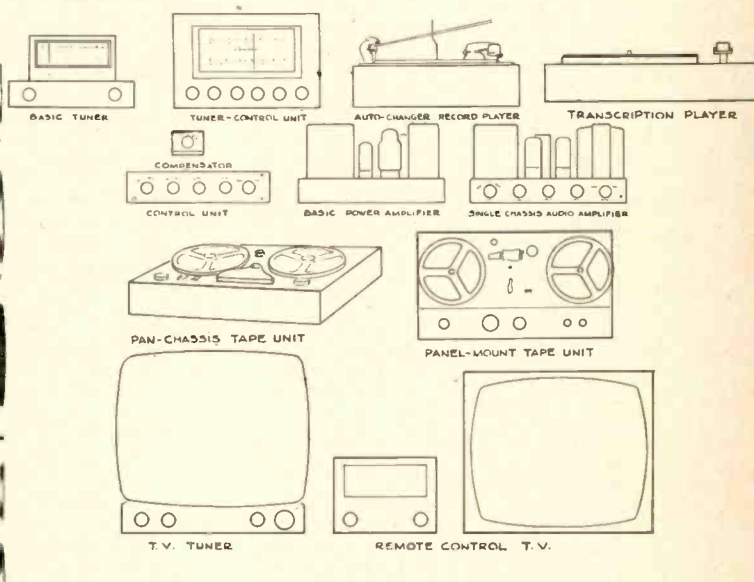




**Fig. 2 (above). Basic outline of twelve types of hi-fi chassis indicating the controls that have to be considered for panel layout.**

**Fig. 1 (left). Block sketch of various types of hi-fi chassis and their relationship to each other in assembling a system. *(Courtesy R.C.A.)***



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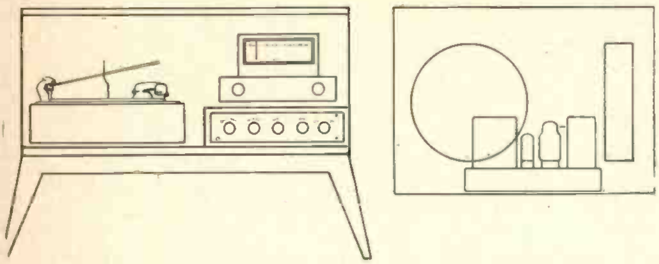


Fig. 4 (right). A compact two-unit music system. Equipment cabinet is simple in design, yet completely functional and attractive. Basic power amplifier is mounted into the speaker enclosure on the right. *(Courtesy R.C.A.)* Fig. 4A (above). Outline sketch of components pictured in Fig. 4.

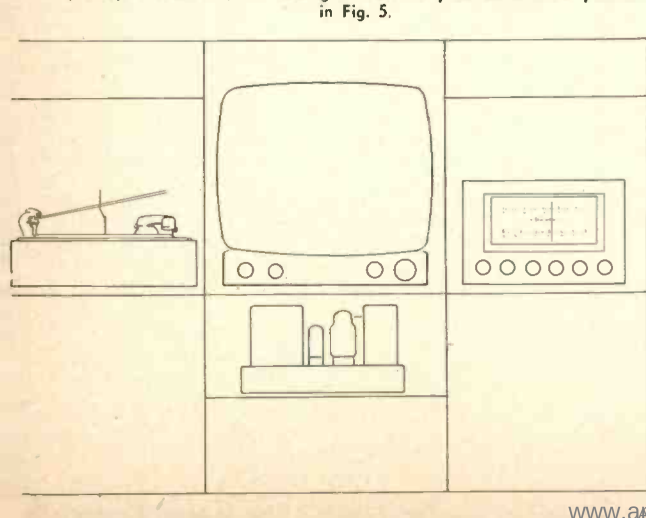
ing thought to enclosures is like selecting furniture for a home or apartment that hasn't yet been seen. The proof of such folly is easily seen in the case of Mr. Jones[2] who decided to "rush out and get a system" after visiting a music lover friend who let him hear his set-up but didn't discuss any details. Not being satisfied with any of the commercial cabinets, Mr. and Mrs. Jones decided to install it into their breakfront. Soon after the equipment was delivered, he called in the cabinet-maker and proceeded to work out the layout of components. He found while planning the layout (something he should have done before he bought a single piece of equipment) that things weren't working out well at all. The one part of the breakfront that was useable for housing the system, didn't have enough space for tuner, amplifier and record player.

The quality of the components was excellent. But, from a practical point of view they were just not compatible or "matched" as hi-fi jargon will have it. The radio tuner, of popular make, was replete with controls. It had everything from record compensator and equalized phono preamplifier to bass and treble controls as well as a loudness control. The amplifier, one of the finest makes, was also replete with controls, duplicating almost to exactness the features of

Fig. 3. A simple basic installation for a hi-fi music system.

[2] The story of Mr. Jones is true. Only the name has been changed to protect the prototype.

Fig. 5 (right). An original wall cabinet design with a clever method of displaying bric-a-brac and other embellishments Note tape recorder placed in the lower center section. *(Courtesy Radio Craftsmen.)* Fig. 5A (below). Outline sketch showing method to plan installation pictured in Fig. 5.



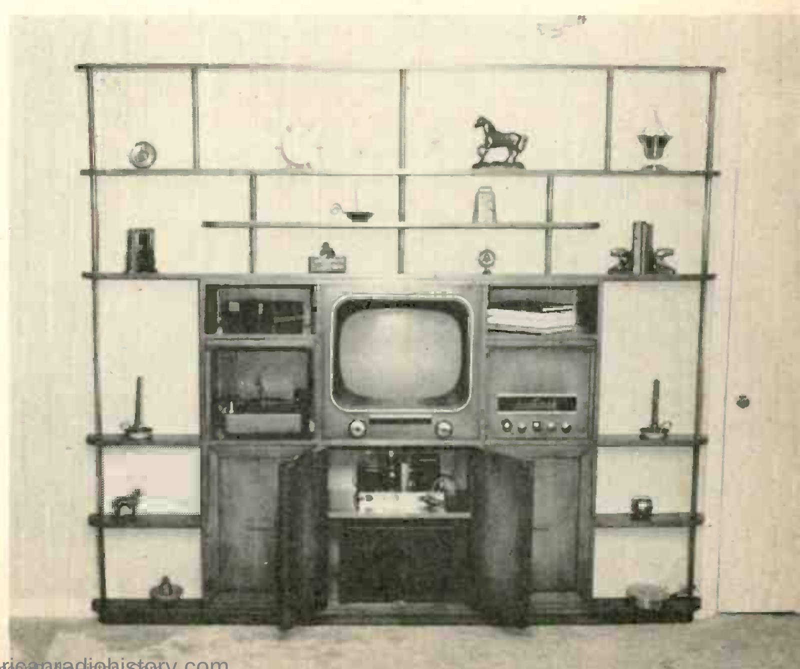


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Fig. 6 (above). A complete entertainment center with every facility for gracious living. Fig. 7 (below). A closet installation containing a complete music system. *(Both photos Courtesy Fisher Radio Corp.)*

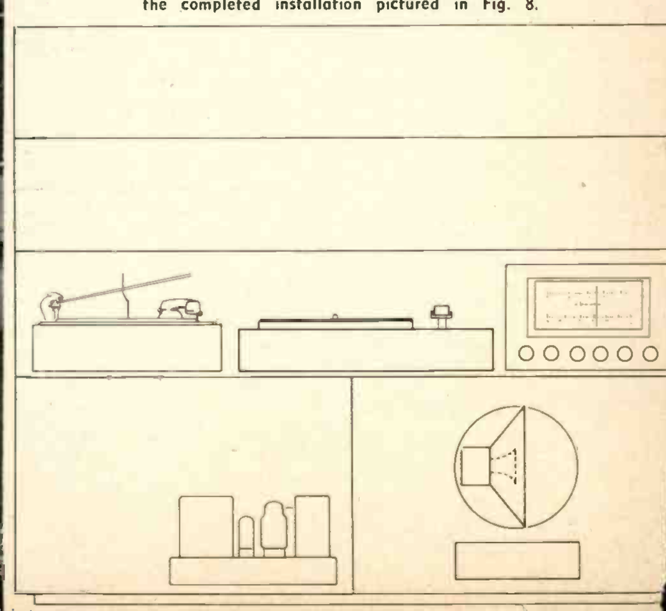
the radio tuner with the exception of the station selection control. Each demanded panel space so the controls could be operated conveniently.

The breakfront was of the average type with massive dimensions and little space for objects having a depth in excess of 9 in. The entire upper section had a depth of 8 in. and was used to show off the family china and glassware. protected by glass paneled doors. The lower section had a center portion that was 16¼ in. deep by 32 in. wide and 24 in. high, with a shelf running across the width making two compartments, each 11½ in. high. Each of the lower side sections was 16 in. wide and 11½ in. high, but only 9 in. deep. Requiring space for record storage, Mr. Jones had planned to place the tuner and amplifier on the upper shelf with the record player. Since the upper shelf was only 32 in. wide and the three units required as much as 45 in., this plan would not work. To place the amplifier below would require the loss of much needed record storage. Besides, the tuner and amplifier mounted one above the other on the upper shelf required a height of more than 14½ in. which is four inches more than is available. Since the amplifier is 13 in. deep it could not be mounted into one of the side sections as they each are only 9 in. deep. Even if it were possible, it would be impractical as poor Mr. Jones would have to perform all sorts of acrobatic feats to operate the radio tuner and adjust the controls of the amplifier as he juggled the doors of the center section to get to the side section.

If he had stopped to do a little planning with the aid of a measuring tape, he would have considered these facts, which unfortunately became apparent to him after he had made his purchases and had given his cabinet-maker a difficult task. He would have found out that a better choice of amplifier would have been a basic power chassis that was void of controls and could be located remotely from the tuner which had all the necessary audio controls. The average basic amplifier is of a dimension that would permit installation into a space 16 in. wide by 11½ in. high and 9 in. deep. Concealed behind a perforated masonite panel it would be unobtrusive and well ventilated for normal operation. It would also be less expensive (for like quality) and eliminate the nuisance of operating two sets of audio controls, which can also create problems of balance and become a source of distortion. Here is a simple and basic situation that occurs every day. Despite any counsel offered by a salesman, the music lover insists upon treading into pitfalls of improper selections because he once read somewhere that such and such a tuner was a good buy and then read somewhere else at a later date that a certain amplifier was one of the best. He had never read anywhere that they were to be used together because any reputable writer on the subject of hi-fi would not recommend the use of a tuner with audio controls and an amplifier that would have a like set of controls. *Figure* 1 illustrates the combinations of various styles of tuners, amplifiers and record players which are compatible for use in a system.

The basic types of component chassis number about twelve, and these include everything from the diminutive record compensator to the huge and heavy pan-type tape-recorder chassis. Outlines of these chassis are illustrated in *Fig.* 2. For effective and practical layout, much consideration must be given the width and height of the components. The minimum depth varies from 12 in. for the average tuner or amplifier to 16 in. for a record changer and 18 to 22 in. for

Fig. 8 (left). A music system mounted into a minimum of wall space. note tremendous record storage facilities available despite the small amount of space this installation occupies. *(Courtesy Fisher Radio Corp.)* Fig. 8A (below). An outline drawing of the original plan that resulted in the completed installation pictured in Fig. 8.



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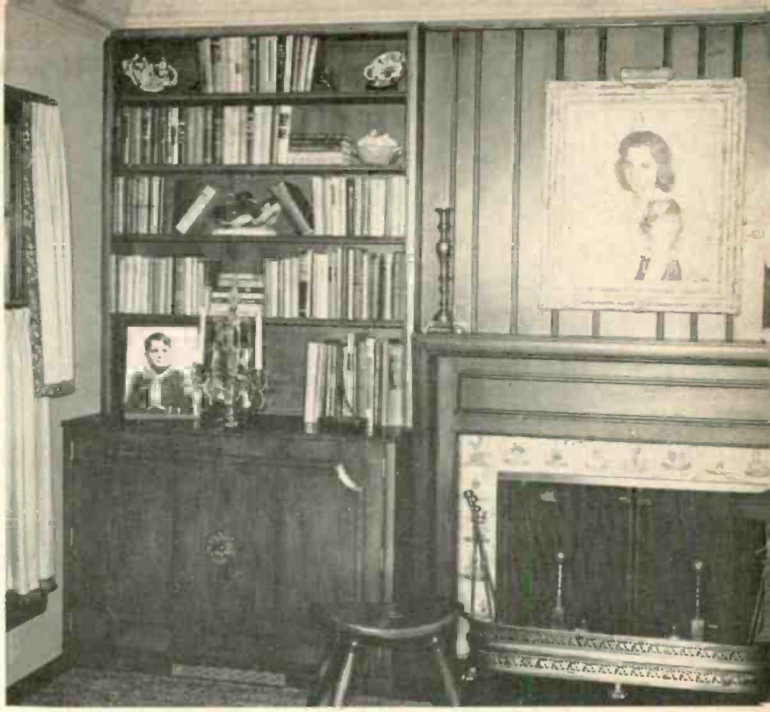

**Fig. 9 (right). A narrow set of bookshelves beside a handsome fireplace was easily converted to house a complete music system. *(Installation by Bennett Music House, Courtesy Radio Craftsmen.)* Fig. 10 (above). Closeup of open cabinet pictured in Fig. 9 showing layout of components.**

a transcription player or pan-type tape recorder.[3]

**Panel Arrangement**

Panel arrangements can usually be made to suit the aesthetic and decorative tastes of the individual. However, they should be resolved before any purchases are made. The information and brochures provided by manufacturers and the catalogs of leading audio dealers contain all of the dimensions and illustrations necessary to lay out a panel arrangement. Commercial hi-fi cabinetry have equipment compartments which permit the installation of components in many panel arrangements. One type, *Fig.* 4, has a width of 32 in., others range from 16 to 18 in. Some provide enough height to mount one component atop another (this is also a feature of the cabinet in *Fig.* 4). Cabinets may be custom built to place the components to suit individual needs as seen in *Figs.* 5 to 12. Average units of furniture to be altered to house hi-fi equipment offer widths ranging from 12 to as much as 48 in., the latter dimension usually being found in bookcases or center sections of sideboards. Height usually runs from 10 to 11 in. in bookcases and as much as usually runs from 10 to 11 in. in bookcases and as much as 30 to 36 in. in sideboards, breakfronts, and credenzas. Depth is often the problem. Record players require a minimum of 16 in. (inside dimension) to permit mounting a base on slides and yet have ample space so as not to damage or wear the insulation of the cables which connect to the amplifier or tuner. The cables must be tacked down, and a sufficient length must be provided to permit the base to be pulled out for use. When the base is pushed back in place, there must be ample room for the cables to fall back without bunching up under the slides to avoid cutting or damaging the insulation.

To lay out a panel arrangement effectively one must understand the functional purpose of each type of component. While there are many more components that can be discussed in an article such as this, there are fortunately only about a dozen basic types that are used in all of the numerous brand names and models (one manufacturer catalogs six separate and distinct radio tuner models). Actually tuners and amplifiers have only two basic chassis outlines each. (See *Fig.* 2.) The listing below covers the function of each basic chassis type.

[3] See table of minimum space requirements: Irving Greene, "Place your music decoratively," Audio Engineering Feb. 1954, p. 24.

**Fig. 11. Here is a simple but very effective manner of installing a complete system into a small area providing an ideal corner for a loudspeaker and a very advantageous location for the television unit. *(Courtesy Radio Craftsmen.)***

*The Basic Tuner.* This unit is usually void of any audio function (such as tone or volume control etc.). Some makes include a single tone control and selector switch for phono or auxiliary (TV or tape recorder playback) if the music lover should wish to use it with a tape recorder, or to modify or improve an existing non-high fidelity radio. The basic tuner may be for AM-FM or for FM only (one or two manufacturers make a unit for AM only for cities where FM is not broadcast). Some types have only two knobs and these include a station selector and a volume control with switch. Other models do not have a volume control since the basic tuner is used with amplifiers having complete audio control facilities which include a volume control. The basic tuner is usually more compact than the tuner-control chassis. When used with a complete amplifier

*(Continued on page 55)*



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# Design of a Continuously Variable Low-Pass Filter Utilizing Negative Feedback Techniques

BASIL T. BARBER*

**The development of the theory behind an R-C filter which is readily controllable, and a presentation of a finished unit employing the resulting filter.**

In a high-fidelity system, in order to eliminate any objectionable noise or record hiss, a low-pass filter is sometimes introduced capable of effectively reducing the noise present without eliminating a considerable portion of the program's musical content which may exist below the cutoff frequency.

Several methods exist utilizing chokes or feedback-type twin-T networks which, in addition to their advantages, also have a number of serious disadvantages. These include hum pickup, ringing, poor transient response, phase reversal at the null frequency, a limited number of cutoff frequencies, and the use of critical or precision components.

A method is presented here for designing a low-pass filter with a continuously adjustable cutoff frequency from 4 to 16 kc and an attenuation rate of 12 db per octave. Over the range from 4 to 16 kc the "peaking" remains the same and is less than 1 db. A 12-db-per octave rate is considered adequate and a number of high-quality control units (Radio Craftsmen RC-300, Stromberg-Carlson AR-425, Electronic Workshop C-5) utilizing chokes have adopted this rate with satisfactory results.

Some familiarity with the concept of the Laplace transforms and the principles of negative-feedback theory is required to follow the derivation of the design equations.

* *Project Engineer, Sperry Gyroscope Corp., Great Neck, N. Y.*

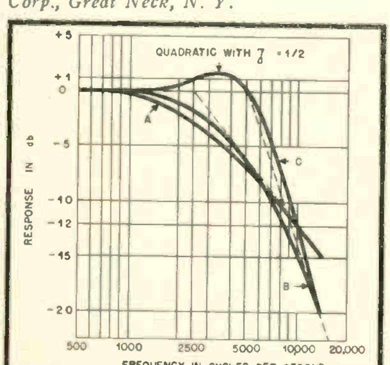



**Fig. 1. Frequency response of a single RC lag, a double RC lag, and a quadratic.**

**A complete preamplifier and control unit which utilizes the filter circuit described.**

#### General Considerations

Referring to *Fig.* 1, let us assume that a 12-db attenuation at 10 kc is required. It is obvious that the smaller the slope, the further to the left we shall have to start attenuating in order to obtain the required 12 db attenuation at 10 kc. The frequency band between the turnover point and the 10-kc point will also be attenuated to a degree proportional to the slope of the curve employed. For example, if a single R-C lag is used with a slope of 6 db per octave, the turnover will have to be two octaves below 10 kc. or at 2500 cps as curve (A) indicates. The signal will be attenuated by 3 db at 2500 cps and 6 db (ideally) at 5 kc. Most tone controls follow this curve and their effectiveness is therefore limited.

By cascading two R-C lags having the same time constant, a 12-db-per-octave attenuation is obtained. The turnover point is one octave to the left, but as seen from curve (B) of *Fig.* 1, the midfrequencies also suffer a proportional attenuation, although not as great as the single R-C lag.

A method must therefore be devised that would minimize all this unnecessary attenuation of the midfrequencies, but still be able to give us the necessary 12 db drop at 10 kc.

*Figure* 2 represents the frequency response of a quadratic equation of the form[1]

$$\frac{1}{(j\mu)^2 + 2\zeta(j\mu) + 1} \qquad (1)$$

[1] Brown and Campbell, "Principles of Servomechanisms," Wiley, chap. 4. Chestnut and Mayer, "Servomechanisms and Regulating System Design," Wiley, p. 311.

In a non-dimensional form, the resonance peak of the curve depends on the value of ζ, the damping factor of the quadratic equation. By making ζ equal to 1/2, a curve is obtained having practically no loss up to an octave before the frequency where the 12 db attenuation is required. The problem can therefore be restricted to making an actual circuit which will follow Eq. (*1*) with $\zeta = 1/2$, utilizing resistors and capacitors only.

#### Methods of Approach

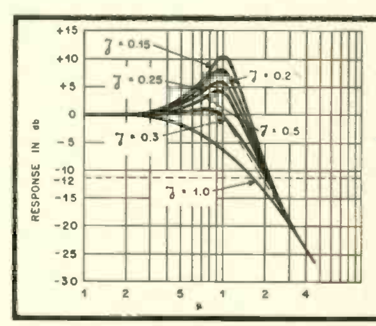
*Figure* 3 represents the network to be employed.

1. Assume that we attempt to solve the problem by cascading two R-C lags having the same time constant. Then,

$$R_b = mR_a, \quad \tau_a = R_aC_a$$

$$K_3 = \frac{3}{40} = \frac{\frac{R_1R_3}{R_1+R_3}}{R_a + \frac{R_1R_3}{R_1+R_3}} \qquad (11)$$

$$K_1 = \frac{9}{10} = \frac{\frac{R_2R_3}{R_b+R_3}}{R_1 + \frac{R_2R_3}{R_b+R_3}} \qquad (12)$$



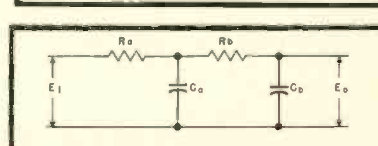




**Fig. 2 (upper). Frequency response of a quadratic lag as a function of ζ. Fig. 3 (lower). Network of resistors and capacitors to be solved for transmission characteristic.**



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And if $R_2 \gg R_1$
$R_3 \gg R_1$

then Eqs. (*11*) and (*12*) can be approximated as follows:

$$K_3 \approx \frac{R_1}{R_1 + R_2}$$

$$K_1 \approx \frac{R_3}{R_1 + R_3}$$

We have two equations and three unknowns. If we make $R_2$ equal 1 megohm, then we have

$$R_1 = 82{,}000$$
$$R_2 = 1 \text{ megohm}$$
$$R_3 = 470{,}000.$$

The total gain will be

$$\left[\frac{9}{10}e_i - \frac{3}{40}e_o\right]40 = e_o,$$

from which

$$A = \frac{e_o}{e_i} = \frac{36}{4}9 \approx 19 \text{ db}.$$

A good compromise for $R_a$ in *Fig.* 3 is 100,000 ohms, and with $m = 5$, $R_b$ becomes 500,000 ohms. Setting 5 kc as the low limit of the filter, from Eq. (*10*) we have,

$$f_n = \frac{1}{\pi RC} = 5 \times 10.$$

Therefore

$$\tau = RC = \frac{10^{-3}}{5\pi} \text{ seconds}.$$

$$C_a = \frac{10^{-3}}{5\pi \times 10^5} = \frac{10^{-6}}{500\pi} \approx 680 \mu\mu f,$$

and

$$C_b = \frac{C_a}{m} = \frac{680}{5} \approx 120 \mu\mu f.$$

#### Complete Circuit

*Figure* 6 presents the complete circuit. The 680- and 120-µµf capacitors are connected to ground through switch $Sw_1$ which is attached on the back of the ganged pots $R_a$ and $R_b$. At the extreme counterclockwise position of the pots the switch opens, giving a flat frequency response to beyond 50 *kc*. The switch opens at a logical point because the extreme counterclockwise position represents the point of minimum suppression. The first cathode-follower can be eliminated as long as the 82,000-ohm resistor looks into a reasonably low impedance (10,000 to 20,000 ohms). The 1-megohm feedback resistor and the 0.1 µf of the cathode-follower output have a time constant of 0.1 second, giving a break frequency

$$f = \frac{1}{2\pi RC} = \frac{10}{2\pi} \approx 1.6 \text{ cps},$$

far enough below the audio spectrum not to cause any trouble.

#### Final Curves

*Figure 7* shows the actual curves taken with the circuit of *Fig.* 6. The circuit parameters have been selected to give the best possible results. The cutoff frequency can be varied from 4 kc (maximum clockwise) to 16 kc (maximum counterclockwise) with a provision for a completely flat response. The overshoot is always less than 1 db at any cutoff frequency selected, eliminating ringing and distortion. Owing to the nature of the filter, no phase reversal exists similar to the one present in the choke or the twin-T feedback-type filter. In addition, since the −180 deg. in the phase domain will be reached only when the frequency approaches +∞, and since at that point the gain will approach the −∞ point, there exists no real frequency at which the circuit may become self-oscillatory.

#### Figures of Merit

The final criterion of any circuit is, of course, a listening test. A large percentage of a group of critical listeners have found that the circuit described definitely eliminates most of the noise and hiss of recorded music without seriously impairing the actual "musical substance" present in the program.

We went a step further and have attempted to determine quantitatively this rather intangible characteristic of "musical substance." The word suggested that if we can measure the area "sliced" between the turnover frequency and the frequency at which the required attenuation is present, we could establish some means of comparison between several curves as to their effectiveness.

Assume again that a 12-db attenuation is required at 10 kc and that most of the noise lies beyond that point. In

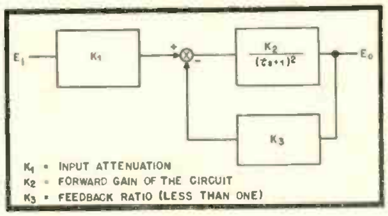


Fig. 4. Network of Fig. 3 with addition of a feedback loop.

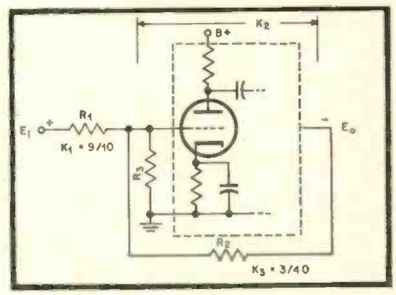


Fig. 5. Practical application of networks.

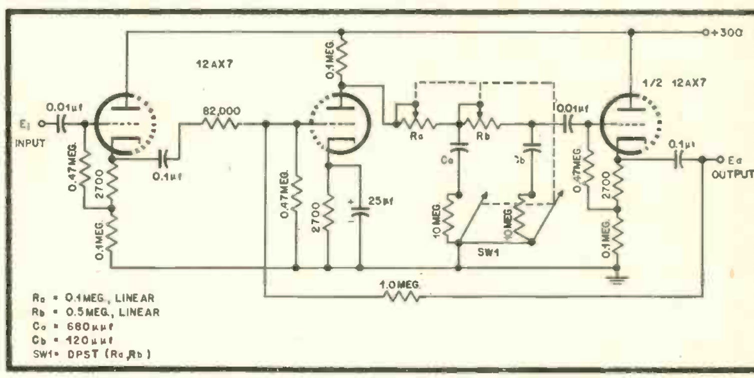


Fig. 6. Over-all schematic of filter giving 12-db-per-octave slope.

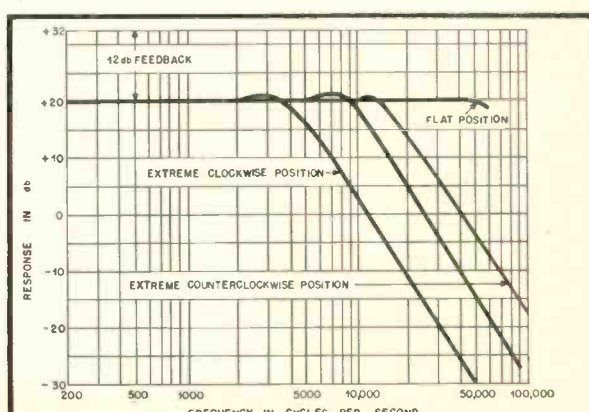


Fig. 7. Frequency response of circuit shown in Fig. 6.



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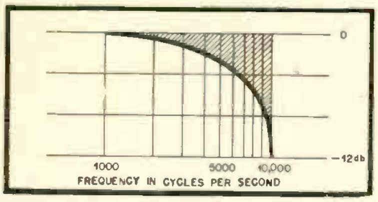


**Fig. 8. Shaded area represents "intelligence" lost to secure desired attenuation at 10,000 cps.**

*Fig.* 8 the shaded area represents the amount of musical energy that must be lost in order to attain the required attenuation at 10 kc. The smaller this area, the more the musical "substance." This area can be calculated by taking the transfer function of the filter employed and integrating it from 1 to 10 kc. The integrals of the double R-C lag and the quadratic with $\zeta = 1/2$ can be quite involved and a planimeter was therefore employed to measure their areas, since what we are actually interested in are their *relative* values.

Referring to *Fig.* 1 we obtain.

$A_1 = 2.6$ for the single R-C lag, curve (A)

$A_2 = 2.2$ for the double R-C lag, curve (B)

$A_3 = 0.8$ for a quadratic with $\zeta = 1/2$, curve (C)

and therefore

$$\frac{A_1}{A_3} = \frac{2.6}{0.8} = 3.25 : 1$$

$$\frac{A_2}{A_3} = \frac{2.2}{0.8} = 2.75 : 1$$

and

$$\frac{A_1}{A_2} = \frac{2.6}{2.2} = 1.2 : 1.$$

$$C_b = \frac{C_a}{m}, \quad \tau_b = R_bC_b = (mR_a)\frac{C_a}{m} = R_aC_a = T_a$$

therefore $T_a = T_b = \tau$

The value of $m$ must be greater than 5 for an effective impedance separation. Letting $\tau = RC$ and using Laplace transforms, we have

$$\frac{e_0}{e_i} = \frac{1}{(TS+1)^2} = \frac{1}{T^2S^2 + 2TS + 1} = \frac{1}{\frac{S^2}{\omega_n^2} + \frac{2\zeta}{\omega_n}S + 1} \qquad (2)$$

and therefore

$$\omega_n = \frac{1}{\tau} = \frac{1}{RC} \text{ (in radians/sec)}$$

and

$$\zeta = \omega_n\tau = \frac{\tau}{\tau} = 1$$

The above can only be approximated if $m \gg 1$. If $m$ is not much greater than 1 however, Eq. (2) becomes

$$\frac{e_0}{e_i} = \frac{1}{\tau^2S^2 + \left(2\tau + \frac{\tau}{m}\right)S + 1}$$

giving a $\omega_n = \frac{1}{\tau}$ as before, but

$$\text{a } \zeta' = \zeta + \frac{1}{2m} = 1 + \frac{1}{2m}$$

For a 10% error in the value of $\zeta$, the value of $m$ must therefore be equal to or greater than 5.

From *Fig.* 2 it is seen that such a network will be unsuitable as analyzed previously, since it gives a loss of 6 db one octave below the cutoff frequency.

2. Suppose the network of *Fig.* 3 is made up of two R-C units having different time constants. Then if $R_b \gg R_a$, and

$$\tau_a = R_aC_a$$
$$\tau_b = R_bC_b$$

$$\frac{e_0}{e_i} = \frac{1}{(T_aS+1)(T_bS+1)} = \frac{1}{T_aT_bS^2 + (T_a+T_b)S + 1} \qquad (3)$$

and therefore

$$\omega_n = \frac{1}{\sqrt{T_aT_b}}$$

and

$$\zeta = \frac{\omega_n}{2}(T_a + T_b) = \frac{T_a + T_b}{2\sqrt{T_aT_b}} \qquad (4)$$

In our case we need $\zeta$ equal to 1/2. Therefore

$$\frac{T_a + T_b}{2\sqrt{T_aT_b}} = 1/2$$

or $T_a + T_b = \sqrt{T_aT_b}$. (5)

No real values of $T_a$ and $T_b$ will satisfy Eq. (5) and therefore the desired curve cannot be attained with this approach either. In addition, since

$$\zeta = \frac{T_a + T_b}{2\sqrt{T_aT_b}}$$

even if the values of $T_a$ and $T_b$ were real numbers, it would have been very difficult to have the values of $R_a$ and $R_b$ made variable with potentiometers of standard tapers and still maintain the relationship of

$$\frac{T_a + T_b}{2\sqrt{T_aT_b}} = 1/2.$$

3. Let us now use the same network we had in the first approach but enclose it in a feedback loop as shown in *Fig.* 4.

Then

$$A = \frac{e_0}{e_i} = \frac{\frac{K_1K_2}{(TS+1)^2}}{1 + \frac{K_2K_3}{(TS+1)^2}} = \frac{K_1K_2}{T^2S^2 + 2TS + K_2K_3 + 1} = \frac{\frac{K_1K_2}{1+K_2K_3}}{\frac{T^2}{1+K_2K_3}S^2 + \frac{2\tau}{1+K_2K_3}S + 1} \qquad (6)$$

and therefore

$$\omega_n = \frac{\sqrt{1+K_2K_3}}{\tau} \qquad (7)$$

and

$$\zeta = \frac{\omega_n\tau}{1+K_2K_3} = \frac{1}{\sqrt{1+K_2K_3}} \qquad (8)$$

and for the $\zeta = 1/2$ required,

$$\frac{1}{2} = \frac{1}{\sqrt{1+K_2K_3}} \quad \text{or} \quad K_2K_3 = 3 \qquad (9)$$

A significant point of Eq. (8) is that the value of $\zeta$ is *independent of the value of the time constant $\tau$ of the R-C networks employed.*

From Eq. (7) we have

$$f_n = \frac{\omega_n}{2\pi} = \frac{\sqrt{1+K_2K_3}}{2\pi\tau} = \frac{1}{\pi\tau} = \frac{1}{\pi RC} \qquad (10)$$

**Design of Actual Filter**

Equations (9) and (10) are all that we need to design the filter. A $K_2$ of 40 can be obtained with a cathode-bypassed 12AX7 or 6SL7.

Therefore

$$K_2 = 40 = 32db \text{ (original gain)}$$

and from Eq. (9)

$$K_3 = \frac{3}{K_2} = 3/40.$$

Also from Eq. (6), the total gain of the circuit is

$$A = \frac{e_0}{e_i} = \frac{K_1K_2}{1+K_2K_3} = \frac{40K_1}{4} = 10K_1$$

and therefore $K_1 = A/10$.

Since $K_1 < 1$, $A$ must therefore be equal to or less than 10. This additional gain of 20 db can be used as gain compensation for tone controls, loudness control, and so on. Since the original gain of the amplifier was 32 db, the remaining 12 db is left in the circuit as negative feedback at all frequencies, reducing the harmonic distortion and improving the linearity and signal-to-noise ratio of the over-all circuit by a factor of 4 to 1.

In *Fig.* 5 assume that both $R_1$ and $R_2$ come from a low-impedance source. $R_2$ is required as a grid leak and therefore it enters into the calculations of $K_1$ and $K_3$. We therefore have,

Taking the single R-C lag as a measuring unit, we see therefore that a double R-C lag is only slightly better and that a quadratic with $\zeta = 1/2$ is at least three times as good. Using the planimeter on the actual curves of *Fig. 7*, we find that:

$$\left.\begin{array}{l} A_1 = 1.0 \\ A_3 = 0.35 \end{array}\right\} \frac{A_1}{A_3} = 3.85 : 1$$

and therefore

$$\frac{A_1}{A_3} = 3.85 \times \frac{3.25}{2.75} = 4.5 : 1.$$

The actual curves are better than a single lag by a factor of 4.5 to 1.

**Variation of Parameters**

The value of $\zeta$ is rather critical and must be maintained at 1/2. From Eq. (8) is seen that $\zeta$ is a function of $K_2$ the gain of the tube and $K_3$ the feedback ratio. If we assume that a maximum deviation of ±10 per cent is possible in tube gains and the values of resistors,

(*Continued on page 54*)



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# The Record Revolution and Music

RUDO S. GLOBUS

**The future of music has left the concert hall behind. The record buyer will be its maker or its destroyer.**

JUST A FEW SHORT WEEKS ago, I sat down to lunch with David Oppenheim, impresario and guiding hand behind the activities of Columbia Records' classical division. Over a bowl of formidable Spanish fish soup, we talked for well nigh two hours about Stravinsky, *The Rake's Progress*, recordings, music, philosophy, aesthetics—and a little bit of gossip thrown in. The ostensible purpose for the lunch was some talk-talk about the recent Columbia recording of *The Rake's Progress*—one of the most thoroughly publicized recording sessions of recent history. For this recording is in its own way a symbol and a symptom of a rather remarkable thing that has happened to this queer world of ours.

If we examine the recording, the session that produced it, and a few other things more or less closely, a pattern begins to emerge. The first performance of the Stravinsky work was widely heralded. A major composer, Stravinsky, and a major poet, Auden, created a new opera. Its premiere performance in Venice got mixed reviews—ranging from the ecstatic to the uncertain. It received a few more performances—including three in the United States.

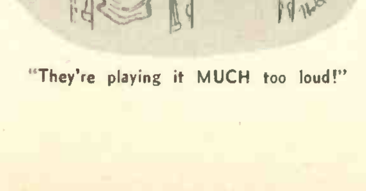
The likelihood is that it will not be performed with any frequency, and there are no indications that it will become a mainstay in the opera houses here and abroad. An overwhelming percentage of the music lovers of this fair world will never have an opportunity to hear a live performance of the opera. Even if New York's Metropolitan Opera Company were to perform it once a year, every year (and this is unlikely), you can figure out that the total number of adults throughout the United States who will hear the work will be identical to the seating and standing capacity of the Metropolitan Opera House.

Whether you like it or not, whether you consider it first rate or second rate (or even third rate) Stravinsky makes little or no difference. *The Rake's Progress* deserves a hearing. So along comes Columbia Records and the work is recorded. This means that everybody and anybody with a record player of one sort or another will have a chance to hear the opus. But *The Rake* is an opera, meant to be seen as well as heard. The libretto, the score—both anticipate stage settings, action, drama. The record listener is compelled to inject these factors by way of imagination—and this is a difficult job at best. Oppenheim has tried his best to help out. Where the original score calls for a piano, a harpsichord is substituted in the recording to supply the sound and feel of period and of setting. Where the live performance compensates for linguistic inaudibility by way of action, the recording has gone the limit to make every last word and syllable distinct and clear . . . while still preserving the texture of vocal and instrumental sound so dear to Stravinsky. Since it is unlikely that not too many more recordings will be made of *The Rake*, every effort has been made to produce an authentic, definitive performance. The composer conducts an orchestra thoroughly rehearsed and familiar with the work in performance. So here we are! The place of *The Rake's Progress* in musical history may very well depend on a recording. What kind of a strange freak of logic is this? Take heed, friendly readers, for we are about to make a pronunciamento marking the most important revolution in aesthetic history since the invention of the printing press!

We know that live music, of necessity, was always limited to a minority of the consuming public. Even today, and in a certain sense, especially today, the opportunities for hearing live performances of the full repertoire in any field are small indeed. We may have more orchestras than before, true. But for the most part, they are mediocre, if not worse. They play the war-horses over and over again and are certainly not competent to attack the problems of new and more difficult composition. Opera, chamber music, solo performances are matters for a few of our major metropolises. Until only a few years ago, the course of the history of music was entirely in the hands of a ridiculously small group of critics, wealthy patrons, musicians, and penny-wise music lovers.

But now things are somewhat different. The major music activity of our time—and probably for centuries to come—lies in the area of recording. The great majority of "serious listeners" hear their music exclusively through this medium—and on their taste, their judgment as reflected in their buying habits depends the future history of music.

In our time—right now, for that matter—artists are establishing themselves entirely through the recording medium. A pianist, Paul Badura-Skoda, a conductor, Munchinger, and an orchestra, the Philharmonia, all sprang to prominence through recordings. Badura-Skoda was well-nigh unknown both here and abroad, and yet a concert appearance in this country was extremely successful. There are dozens of cases of such phenomena. And now, with better equipment, better recordings, the record "personality" is surely going to become the musical "personality" of our time—an unseen name on a record label.



"They're playing it MUCH too loud!"

The significance of this revolution is staggering. Let's take another case. A remarkably large percentage of recordings since the advent of LP are of music that has never been heard in an American concert hall. An even larger percentage has had one or two performances in a span of over a hundred years. Already recordings are being produced of new works which have had either no live performance, or an esoteric one at best. During the formative stages of the LP market, a number of music entrepreneurs have appeared who have been willing to sell to specialized markets, making small amounts of profit on small pressings. The ancient music market, the modern music market, etc., have made possible record activities which the major manufacturers have ignored. Sooner or later, this type of activity is doomed. The small record company comes into being, exists for a short period of time, and then dies out. The crucial core of record manufacturing—and consequently music making—lies in the hands of the few large or comparatively large companies. It is they who will create the concert artists, the orchestras, the repertoires of the future.

But not so fast! The record business is just that—a business. If the overwhelming majority of the record-buying public shows an inclination to buy experimental modern music, the record manufacturer will record it. If the record-buying public rejects second rate orchestras, soloists, conductors, and so on, so will the record companies after a while. Everytime anybody plunks down the $5.95 (minus 30 per cent off) for a 12-inch LP, he is directly affecting the course that music is to take in this world. The critic is less important in such a situation, for if he fails to influence purchasing patterns, his plaudits or his agonizing groans and moans will mean absolutely nothing to the powers that be.

The public—the record-buying public—can reduce music to a gross mediocrity. They have done so in the past and are fully capable of doing so again. If we pay attention to the analogy of the printing press and the book, major works of literary

(*Continued on page 59*)



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# Handbook of Sound Reproduction

EDGAR M. VILLCHUR*

## Chapter 17. System Assembly

**While individual components should be well made, matching and connecting them properly is what makes a good system.**

THE PERFORMANCE CHARACTERISTICS of an audio reproducing system are not exclusively dependent upon the quality of the individual components. It is possible to lose some of the potential fidelity of such components by improper assembly, and system design as well as unit design must be considered as part of the reproducing problem.

The objectives involved in the design of the over-all system may be listed as:
1. Choice of the quality level of each unit so as to create a balanced system, in which strong links are not wasted by having to work with much weaker ones.
2. Correct electrical inter-connection and physical layout to take full advantage of the quality of each unit.
3. Operating convenience.
4. Adequate ventilation and easy removal of parts for servicing.

### Selection of Components

We have seen that the electro-mechanical reproducing units, and particularly the loudspeaker, cannot be expected to live up to the standards of a high-quality amplifier. Primary attention must therefore be directed to the former components. No simple rule about the subdivision of the budget among the various units can be made, except to state that as good an amplifier as possible should be chosen first. When the budget is severely limited, one possible procedure is to select speaker, record player, and pickup with the minimum possible requirements, and then to purchase the best amplifier possible with the remainder of the money.

Where speaker systems with good low frequency response are used the hum level of the electronic components, and especially of the preamplifier stages, must be especially low. A preamplifier which is acceptable in a medium-grade system can fill the room with 60 cps hum when playing through a horn-loaded woofer. Conversely, the finest speaker will show off the distortion characteristics of a poor amplifier, but even a medium-quality speaker will sound "clean" with a good amplifier.

* *Contributing Editor,* AUDIO ENGINEERING.

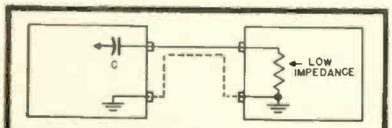


Fig. 17—1. Bass discriminating voltage divider formed by connecting a high-impedance output circuit to a low-impedance input. C has a high reactance at low frequencies compared to the input impedance.

### Electrical Inter-connection of Components

Commercial audio components such as amplifiers, preamplifiers, and pickups normally have high-impedance inputs and can usually be connected one to the other without having to worry about careful impedance matching. Occasionally an amplifier will have a set of low-impedance input terminals; a high-impedance line should never be connected to such terminals, at the peril of severe bass attenuation. The bass discriminating voltage divider formed by such a mismatch is illustrated in *Fig.* 17—1.

The higher the total impedance across an interconnecting cable (that is, the output impedance of one unit in parallel with the input impedance of the other) the greater will be the tendency of the line to introduce high-frequency losses and to pick up hum. The cable capacitance does not have much effect on high frequencies if it is shunted across a low impedance, and, as pointed out in Chapter 15, the impedance across the line forms the lower arm of a voltage divider across which hum voltages are applied. Many modern preamplifiers and control units, which are apt to be located at positions physically distant from the amplifier, often provide low-impedance cathode-follower outputs that solve the problem of hum pick-up and treble loss, and can be connected directly to the normal input terminals of the amplifier.

Interconnecting cable between high-impedance terminals should be of low capacitance. Shielded cable with composition (not rubber) insulation, of about 25 μμf per foot, is suitable, and should be kept as short as is practical. Where the cable must be fairly long a shunt resistor of 50,000 ohms or so across the input may help the situation *provided* that the output circuit is designed so that it can be connected to a load of such low impedance. If the plate resistor of this output circuit is of the order of 50,000 ohms, and the output capacitor is 0.25 μf or higher, the relatively low impedance input is proper. The assembler may wish to convert the output circuit to this design; in such a case the bias resistor must be changed to suit the new load. The correct value of bias resistor can be found in the R-C coupled circuit charts of receiving tube manuals.

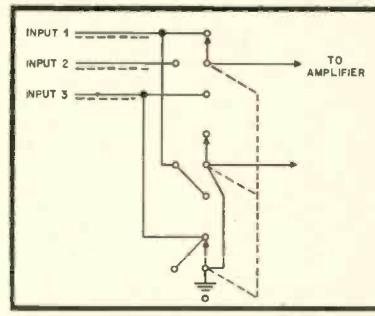


Fig. 17—2. Signal selector circuit that grounds out unused channels to prevent cross-talk.

The cable connecting the speaker to its appropriate winding of the output transformer is in a circuit of such a low impedance that ordinary rubber-covered lamp cord may be used. Flat TV transmission line is also convenient in this application, as the cable can be conveniently laid under rugs or tacked to mouldings. A transformer winding having an output impedance of 500 ohms can be employed, in conjunction with step-down transformers at the speakers, where it is important to minimize IR losses. This procedure is often followed when the signal is distributed over various parts of a building and the length of cable becomes excessive.

In order to prevent capacitive pick-up between signal inputs, which could, for example, introduce a faint background of radio program material while records are being played, the circuit of *Fig.* 17—2 may be employed. This arrangement grounds out all input cables other than the one being used at the moment.

A typical signal cable network is shown in *Fig.* 17—3. Ideally there should be a separate type of connector for each part of the network so that a



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plug can never be inserted into the wrong socket, but if such a scheme is not feasible the next best system is to color code all male and female matching connectors.

The power plugs of the various units should be connected in such a way that the entire system can be turned on and off from a master switch, as illustrated in *Fig.* 17—4. The relative polarity of each plug must be tested for minimum hum. The record player, of course, requires its own series switch, so that the turntable motor can be turned off while the radio is playing. The added load on the single master switch does not normally even approach the overload point.

If remote switching is desired the least expensive solution to the problem is a relay system, in which only low voltage appears across the power cables and long runs can be installed by a non-licensed electrician. Such a system is illustrated in *Fig.* 17—5.

A.c. power cables should never be laid close to or interlaced with signal carrying cables.

The voltage gain of an amplifier must be sufficient to provide an adequate signal voltage at the output stage grids when a specified input signal voltage is applied. However, a large surplus of gain, besides being wasteful and introducing added amplification which is necessarily imperfect, can also be responsible for a degradation of the signal-to-noise ratio.

The hum and noise produced by stages after the volume control receive full amplification no matter what the position of the volume control slider. When there is too much gain following this control the operator can turn down the gain to secure the desired signal level, but the hum produced by the stages following the potentiometer remains at a high level. This condition is illustrated in *Fig.* 17—5, in which the hum produced by audio stages incorporated in a tuner meets more gain than is required by the tuner signal. One solution to the problem posed in *Fig.* 17—5 is to decrease the gain of the tuner audio stages by negative feedback.

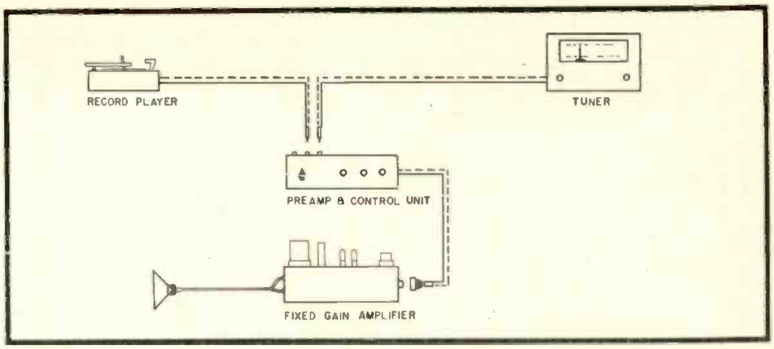


Fig. 17—3. Typical network of signal-carrying cables in reproducing system.

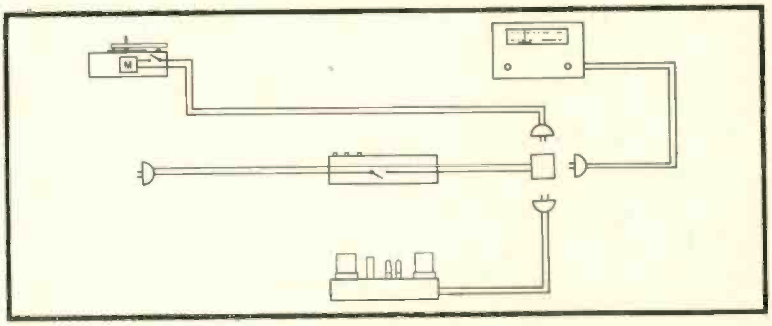

Fig. 17—4. Typical network of power lines in reproducing system.

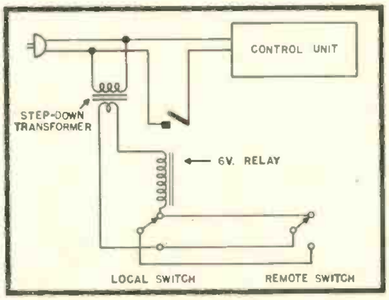


Fig.17—5. Remote on-off switching system with relay. *(After Vino.)*

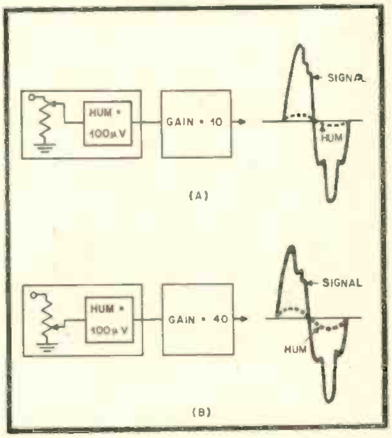


Fig. 17—6. Degradation of signal-to-noise ratio by the presence of too much gain after volume control. *(After Vino.)*

### Physical Layout

The plan of component layout involves two dangers from the point of view of performance—that of hum pick-up from adjacent units, especially those of an inductive nature, and that of acoustical feedback.

Acoustical feedback is commonly set up between the loudspeaker and low-level microphonic tubes, or in some cases between the speaker and the pickup. The coupling may be through the back wave of the speaker, or through mechanical vibrations of the cabinet. The best procedure is to mount the speaker in a separate cabinet, but where this is impossible the judicious use of acoustical "shielding," in the form of sound absorbent material, may solve the problem.

The location of low-level units such as preamplifiers or magnetic cartridges, relative to power supplies, is critical from the point of view of hum pick-up. When the designer is committed to an unfavorable layout with regard to the physical location of the power supply of a particular component, an added power switch for this component may supply the necessary relief. For example, a switch in series with the tuner power switch, ganged to the radio-phono selector, can be used to turn off the tuner during phonograph operation.

Electronic components do not have to be installed right side up, but when they are to be placed on their sides mounting data on the rectifier and output tubes, available in tube manuals, should be consulted. Certain tubes can be mounted in any position, while others, when not upright, can only be mounted with particular pins horizontal. If such specifications are not followed there is an increased danger of tube failure due to sagging elements.

The design of the standard radio console, in which the dial and controls are placed on a vertical panel a few feet from the floor, is sometimes used as a precedent even when the installation does not require it. It is a convenience to be able to tune without stooping or knee-bending, and a wall installation can have the dial at eye level with good effect.

Bottling up tubes and parts in an air-tight chamber, especially when the heat-dissipating rectifier and output tubes are included, will normally decrease the trouble-free life expectancy of the system. Cross-ventilation should be provided in some form whenever possible.

*(Continued on page 39)*



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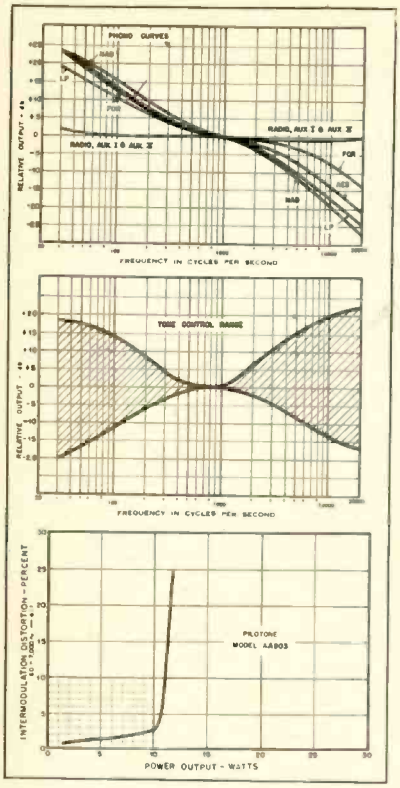


Fig. 1

# Equipment Report

## FM-607 Pilotuner and AA-903 Pilotone Amplifer

**M**OST MUSIC LOVERS are willing to settle for a record player, an amplifer, and a speaker as the basic elements of their home music system, but from an economic standpoint the addition of a good FM tuner would increase the available music by a great amount with a relatively small increase in the cost of the entire system. True, there are a great many tuners on the market, and some of them are fairly expensive—especially when they are equipped with tone controls, selector switches, and all the elements of a preamplifier-control unit. However, for the system in which the controls are already available on the main amplifier—or on a separate preamplifier unit—the tuner does not have to represent a major purchase to offer the equivalent in hours of music that would require many feet of shelf space for storing LP records. In the FM-607 Pilotuner, shown in *Fig. 2*, the entire cost of the additional unit represents not more than a dozen LP's (at list prices) and the rewards in hours of music are well repaid.

Although the FM-607 does not provide for use with magnetic pickups without an external preamplifier, it does have a switch position which permits the connection of a crystal pickup to the tuner—or a magnetic pickup with an external preamplifier—and the selector switch chooses between phono and radio, the latter being accomodated with two positions, one with a.f.c. and the other without. Sensitivity is adequate for use in most metropolitan locations with the line-cord antenna, but fringe locations would require a better signal collecting system.

Technically, the tuner circuit comprises a tuned r.f. stage, a mixer-oscillator, an a.f.c. tube, two i.f. amplifier stages, and a ratio detector. A dual triode serves as a cathode follower output stage and as an additional a.f. amplifier which may be switched in or out. When this stage is in the circuit, the volume control is operative—when the amplifier is out of the circuit, the volume control does not operate. Output impedance is 500 ohms, from the cathode follower, which permits the use of a shielded output cable up to 100 feet in length.

In operation this tuner was noted to have good noise reduction qualities, to be easy to tune, and to have good audio quality in the presence of sufficient signal, equivalent to some more expensive sets.

For a low-cost installation, the FM-607 can be used with a basic power amplifier, —one having no controls—using the built-in volume control as the only variable element. The power switch controls an outlet on the rear apron, and the amplifier can be energized when the tuner is turned on. For a more elaborate installation, the tuner can be used without the amplifier stage, resorting to the controls on the main amplifier or on the preamplifier-control unit.

### AA-903 Amplifier

A suitable companion to the FM-607 tuner is the Pilotone AA-903 amplifier. This model—shown in *Fig. 3*—provides for either magnetic or crystal pickups, the latter in one of the AUX inputs, furnishes compensation for four recording characteristics, and provides adequate power for medium sized listening rooms. Separate bass and treble tone controls give as much as 20 db of boost or cut, and the phono curves match present standards. The IM distortion is about normal for 10-watt amplifiers, as shown in the performance curves, *Fig. 1*.

The circuit consists of preamp stage employing a 12AX7 and giving suitable equalization LP, NAB, AES, and foreign (FOR) recordings. One desirable feature is the use of a variable resistor for a load on the phonograph pickup, so as to match any required value. The resistor is calibrated at 6800, 15,000, 27,000, 47,000, and 100,000 ohms, although any intermediate value can be obtained since the control is continuously variable. The selector switch follows the preamp stage, and at this point the desired input signal—phono (four curves), radio, or either of two auxiliary inputs—may be selected. A two-section volume control is used to reduce possibility of overload on early stages, and the tone controls are located between two sections of the second 12AX7. Two triode amplifier stages are next in line, followed by a cathodyne inverter which drives the 6V6 output tubes. Feedback extends over the output transformer and the three final stages, and 4, 8, and 16-ohm output impedances are available. The schematic is shown in *Fig. 4*. The power switch is combined with the volume control, and energizes a receptable on the rear apron of the chassis.

The amplifier has sufficient sensitivity for most of the magnetic pickups now in use, and more than sufficient for radio and typi-

(*Continued on page 60*)

Fig. 2

Fig. 3

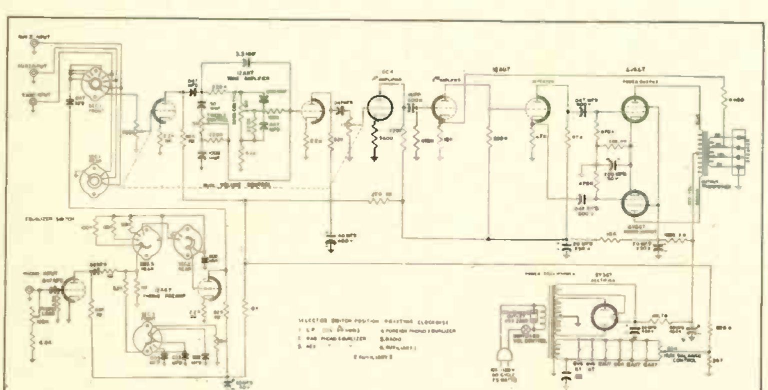

Fig. 4



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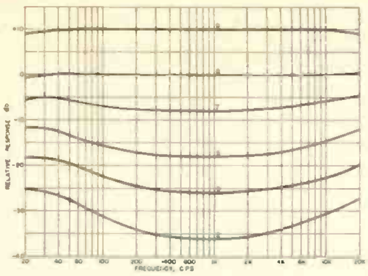
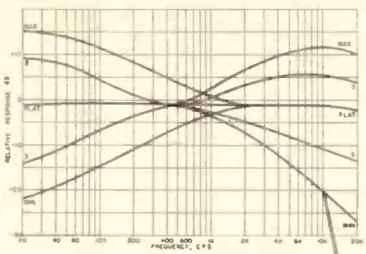
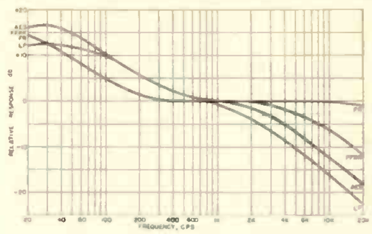


Frequency response curves showing action of loudness controls.



Frequency response curves showing action of bass and treble controls.



Frequency response curves showing record playback characteristics.

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TREBLE CONTROL

- Control provides .......... 12 db. boost, 20 db. droop at 10,000 cps.
- Loudness control provides .... 6 db. boost
- Maximum Treble Boost ...... 18 db.

BASS CONTROL

- Control provides .......... 15 db. boost, 20 db. droop at 30 cps.
- Loudness control at 10% rotation .......... 10 db. boost
- Maximum Bass Boost ....... 25 db.

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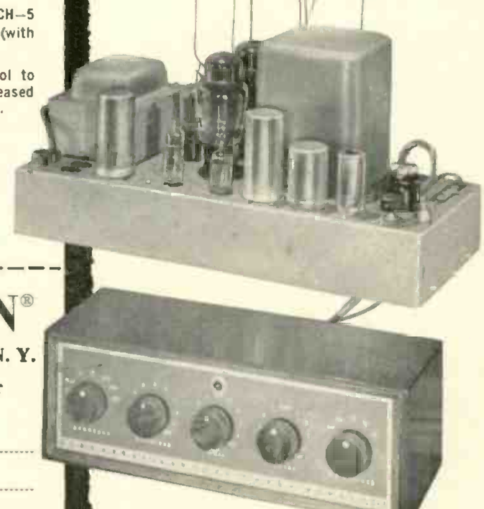
**LOUDNESS CONTROL**—three-section control to boost bass and treble as volume is decreased in order to follow Fletcher-Munson curves.

**INPUT SELECTOR SWITCH**

7 POSITION: Microphone, F.F.R.R. (full frequency range recording), FR. (foreign), L.P. (long playing), A.E.S. (Audio Engineering Society), Radio and Auxiliary (television, tape recorder or crystal phono).



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EDWARD TATNALL CANBY*

## The Angels Sing

**N**OTE. I was the guy who hollered for factory-sealed records—and thanks to an order mixup I didn't get to see and hear any new Angel records until now—which is quite awhile before you read this, as usual. If not the first to hail the recording Angel, Factory Sealed, I'm bound to offer my congrats for the thoroughness with which this U.S. offshoot of the great EMI concern (as London is U.S. offshoot of English Decca) has set up the new system.

It's not cheap, nor is it simple. The sealed records come in one envelope, must be transferred to an ordinary slip-over with a solid back, then in turn slid into the outside jacket—all this after removing a vast outer area of cellophane or glassine. In this initial process the static generation is immense (in winter at least) and the record instantly absorbs to itself all the neighborhood dust. These are *not* static-free discs! Nevertheless the back of the trouble has been broken here, if only in the necessary new distribution setup which must of course go along with these sealed records. "It can be done."

What is left to do? The discs themselves are of high quality material but not markedly more so than other reputable non-sealed brands; there is a bit of noise and popping here and there. These are simply good normal records—sealed and new. (They're available unsealed too, at lower prices.) They are as subject as ever to static, dust, damage, after you buy them; once opened they are definitely unsealed.

I'd say that the following ultimate steps need to be added to Angel's (and others'—notably Cook's) pioneer step.

1. *We desperately need records that are initially static-free.* RCA records are supposed to be, but their claims are remarkably underplayed, considering the importance of the fact. A disc that will not build up static charges is automatically 100 per cent improved as to life expectancy and performance over one that does charge up.

2. We need not only factory-sealed discs but a far better way of *keeping them sealed,* between playings. Capitol is experimenting with the limp plastic envelope; it works but is clumpsy except in boxed sets—and it builds static up as violently as a swatch of genuine cat's fur. Bad.

Walco is issuing the plastic bags shortly, for standard records, and I'll report later in detail—but I am certain that ingenuity is needed to work out a foolproof and simple seal for *opened* records. What say, gentlemen, gadgeteers and inventors? What are your ideas?

### ANGEL

**Rossini-Respighi: La Boutique Fantastique.** Philharmonia Orch., Galliera.

**Angel 30001 (10")**

**Musique Militaire Francaise.** (French Military Music.) Batterie et Musique de la Garde Republicaine, Brun.

**Angel 35051**

These I'd pick as the immediate hi-fi best prospects from the batch of Angels I have on hand—one light (quite light) classic, in frothy ballet style, the other an old-fashioned military band, French type. Both have been superbly recorded, clean, nicely alive, without stunts and tricks. The comparison with London ffrr will be especially interesting since this is London's closest competition at home, and the ffrr sound is, as we all have heard, sometimes a bit on the tricky side. Matter of taste as usual.

The Rossini is a delight in sound and in music too—for a while. It's sort of William Tellish (Heigh-O Silver) stuff. The French band musically, makes me realize anew how much Mr. J. P. Sousa did for our own band music. It may bring ready tears to every Frenchman's eyes—they have UMT, remember—but I find the stuff pretty dreary alongside the Stars and Stripes.

Set this up next to last month's Westminster Deutsche Kapelle Austrian band records. Nice comparison.

**Humperdinck: Hansel and Gretel.** Eliz. Schwartzkopf, Eliz. Grummer, Else Schurhoff et al, boys' and girls' choirs, Philharmonia Orch. Von Karajan.

**Angel 3506B (2)**

A new and charming "Hansel und Gretel," as far as I've played it, and surely a definitive one musically. Recording is superb, the cast is solidly Teutonic along with the conductor, though the children's choirs and the orchestra are British. In German, of course, with translation.

The innovation here is the close-to, low-level singing. This is an intimate opera and yet paradoxically it was scored for big orchestra and is normally presented on large stages where the singers of course must sing loudly—even when the plot calls for "singing to one's self." That is standard opera convention, and nobody minds. But on records there are new possibilities, here exploited nicely. The singers can—and do—more or less sing to themselves when the story says so; they talk in whispers, too, all in a truly fireside manner! Wonderful, except that in a way it makes for a stylistic absurdity; a complete transition—say into a TV opera-play—would logically call for a small orchestra and even for rewritten music to make it possible to sing really, literally, as the plot indicates. A new opera is the ultimate answer if you want to be logical, but that isn't the intention here; and so the music is still the large-scale stuff Humperdinck wrote and it does sound a trace incongruous, the vast orchestra (in a big opera-house liveness) backing up a whisper-sung colloquy between singers at a few inches' distance!

No matter. This is a beautiful version and you'll be amazed at how well the compromise in technique works out.

**Ravel: L'Heure Espagnole.** Artists Orch. of the Opera Comique de Paris, Cluytens.

**Angel 35018**

Strange how this more modern opera of Ravel's (it's called a musical comedy) adapts itself so much more easily to the recorded technique than "Hansel"! Somehow in the 20th century most composers have unconsciously felt or even anticipated 20th-century ways of doing things even before they existed in fact. This chatty, conversational opera also uses a big orchestra but it doesn't "sound big" in the heavy German Humperdinck style; it glitters, blends, surrounds and sets off the solo voices for all the world like radio-TV music, though it was composed about 1907, long before any such music was conceivable. (In fact modern show music owes a huge debt to Ravel for orchestral color and a general "dressiness," that ever so clearly did not come from German music.)

Story concerns a humorous set of intrigues in a Spanish clock shop, people hiding inside grandfather clocks and the like. The fine sound of dozens of clocks ticking, bells ringing, mechanical bird songs trilling, appears at the very opening of the opera and will endear the recording immediately to every hi-fi listener. Exceptionally fine vocal recording.

**Ravel: Piano Concerto #2 in G. Faure: Ballade.** Marguerite Long, piano; Paris Cons. Orch., Tzipine; Cluytens.

**Angel 35013**

This is one of the two Ravel concerti written under considerable American influence, notably that of Gershwin—just how much seems to depend on the performance, oddly enough. There are pages here that to us "reek" of Gershwin—not so much in the melodies, which are Gershwin enough, but in a certain brashness and raciness of color that Ravel surely picked up hereabouts. European performers, to my ear at least, seem to miss the point here in some subtle but devastating way—the "American" part just quietly disappears, though the notes are the same.

Marguerite Long, long one of Europe's first pianists, can hardly be said to do less than a good job on Ravel—but again there is a strange lack of finesse, of that crackling electric quality, that brassy hard-boiled American joyousness, that would seem to me to be of the concerto and



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in it. The orchestra is peppy, but (consistently) shares the pianist's interpretation, or vice-versa. Beautiful recording, though not quite as spectacular as the Angels listed above.

The sweet and sentimental Faure Ballade, a kind of feminine counterpart of the familiar Franck Variations Symphoniques for piano, are much more "on the beam," and not likely to be done more pleasantly than here.

**Ravel: Piano Concerti #1, #2.** Blancard, Orch. de la Suisse Romande, Ansermet.

**London LL 797**

(Technically, number 1 is the Concerto for the Left Hand, number 2 the Concerto in G.) This version with the famed Ansermet has both of the Ravel American-touched concerti and is an even more positive example to my American ear of a strange misconception of the very feeling Ravel must have been after. Again, it's anything but a poor performance, but I feel in place of the required raciness, an ill-defined seriousness—like a joke told without the point really being quite understood. Admittedly I put myself on a limb with such necessarily vague and general suggestions, but I think a good study of these versions will bear me out. I feel (and I know there is disagreement) a similar lack of the proper electricity in Ansermet's Stravinsky, in spite of his special position as the first conductor of numerous Stravinsky works. A matter of style.

**Bartok: Concerto for Orchestra.** Philharmonia Orch., von Karajan.

**Angel 35003**

This work presents problems interestingly like those of the Ravel, above—though minus Gershwin. The Concerto is nominally "old fashioned," in that it is composed for large and complex orchestra and has many points of "Romanticism," so-called, that bring it to some extent into the older symphonic field for many listeners, compared to numerous other modern works. But this is misleading, and has misled the Angel recording technicians. The work actually is full of "close-up" effects, sharp, colorful modernisms —it is literally a concerto for orchestra in which the solo parts are spread out (often in pairs—two clarinets, two oboes, etc.) through the whole ensemble, an idea that is closely related both to Bach (Brandenburg Concerto number 3, for instance) and to modern practice in composers as widely varied as Hindemith, Stravinsky and the writers of modern jazz.

In other words, this music needs a close-up, sharply defined treatment, both in the performance and in the recording. Instead, Angel gives it a fine, fuzzy distant aura of Brahmsian splendor, a grand sound but not at all suited to the piece—the solos are constantly lost in the distance, the sharp, acid details of the music are softened far too much for effectiveness.

If you want to hear this work rightly played and recorded (my idea at least), try the oldish Columbia LP version (ML 4102) under Fritz Reiner. Quite dead acoustics, the solos beautifully close-to and well defined, and the interpretation too has the razor-sharp intensity of modern jazz, which is very, very much in the music. Originally a disc job I think, but it was one of the best of the early LP's and its only fault now in my copy is crackly surface. (Newer copies should be better.)

**Wilde: The Importance of Being Earnest.** Gielgud, Edith Evans, Pamela Brown et al.

**Angel 3504B (2)**

This ultimate and timeless example of witty English froth has recently made a wonderful film in color—those who have seen it won't forget the ornate and preposterous Aunt Augusta, grand dame of the naughty Victorian age, the suave Earnest, otherwise known (in the country) as Jack, and the incredible Miss Prism, a lady who is not so distantly related to Little Buttercup in "H.M.S. Pinafore." Timeless just because it is so utterly without special intent, drawing no morals or theses but simply making fun of an advanced state of high society in any sophisticated town in any age—this play is as funny now as it was in 1895. The top British actors here do the expected job of stylistic finesse—the only



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trouble, perhaps, being a certain difficulty at first in telling one from another, so well trained are the voices and accents.

Extremely fine speech recording (except for inner grooves on long sides), very natural and without bomminess in the male voices even on large-bass speaker systems. (See also T. S. Eliot's "Murder in the Cathedral," at the moment out of stock, due soon.)

## Tonal Ingenuity

**Partch: Plectra and Percussion Dances.** Played by the Gate 5 Ensemble. **(LP-1)**
(Gate 5 Ensemble, 3030 Bridgeway, RFD 67, Sausalito, Calif.)

The principle of revolution is an interesting one. It seems that, thanks to people's normal desire for things "as is," the status quo, it takes much more than plain reason and logic to jolt them into appreciating new things. (They're likely to be scared of them, anyhow, as we all know.) In the scientific fields we are at least open to the persuasion of facts, though what really counts in the end is the evaluations we attach to facts. But in the arts, it is the sense of things that count, the interpretation, and so new advances are likely to be scoffed at automatically just because they are different.

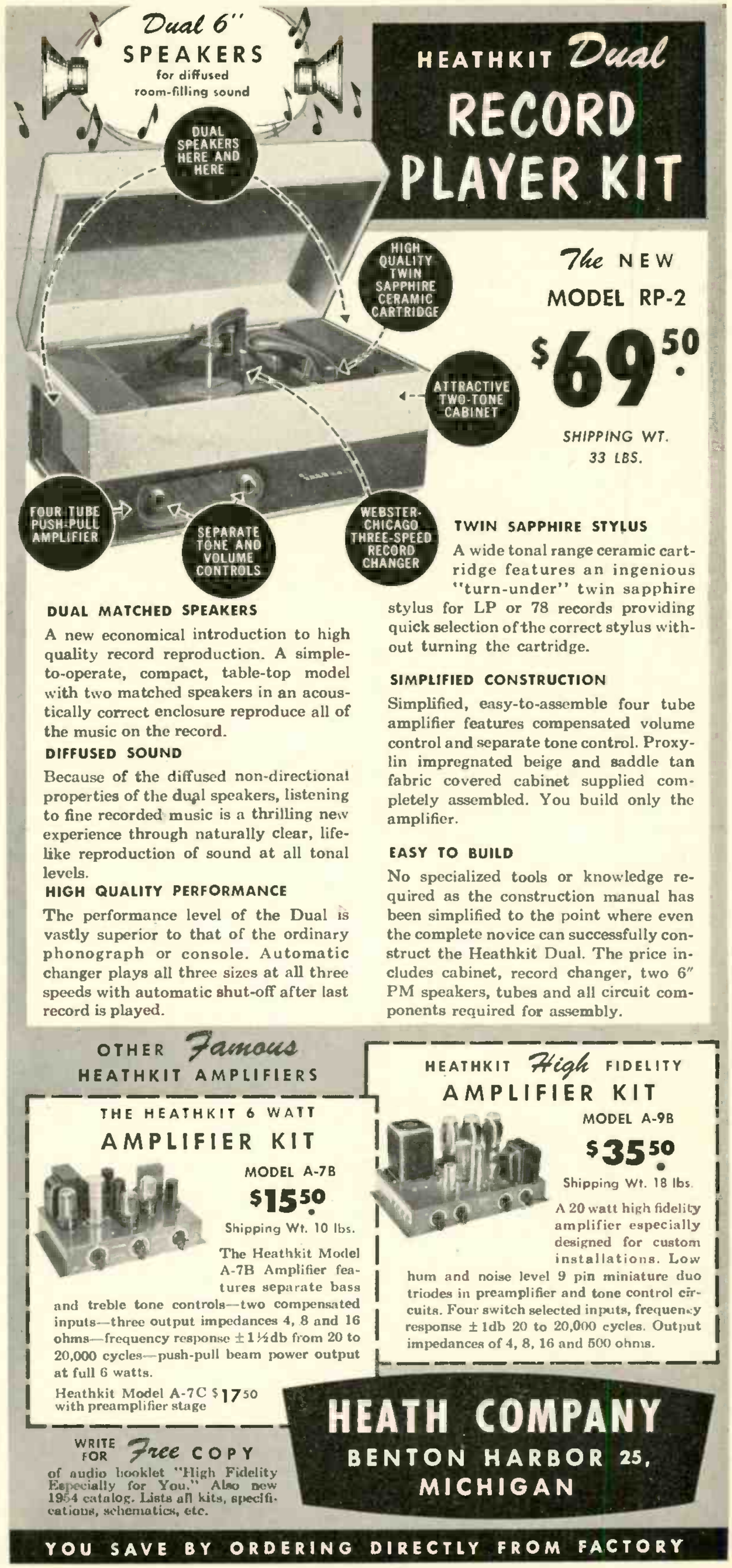
Thus artists with new ideas have to be radicals —as violently radical as the rest of us are comfortably conservative and satisfied. One can spot this situation in an instant—and be aroused to scorn or laughter as quickly; for these people are dedicated, intense, one-track obstinate, ultra-logical (so they think), they don't know when to stop (from our point of view), they carry their theories to an impossible ultimate "no compromise;" moreover, there is almost always that typical building-up-to-a-cult, that is necessary in order to sustain the whole experiment; there are inevitably the devoted, fanatic followers who are passionately faithful and will brook no criticism. (Indeed they usually show an extreme sensitivity to criticism where the "boss", the creator himself, does not—he is serenely confident in his own destiny and that of his work and no longer even worries about critics!)

That is the background for the very strange noises here produced, in utmost seriousness and after fantastic labors, building the instruments, learning to play them, composing. On paper the Partch musical system is impressive, with a special 43-note scale, a Philosophy for creative music (Bold not mine) plus a set of extraordinary gadget-instruments—a Surrogate Kithara (6 strings each on two long resonating boxes), an Eroica (wood block), Cloud-Chamber Bowls, Adapted Viola (attenuated neck for microtonal scales) and plenty more—plus an elaborate collection of symbolic "stories," satires, Greek legends, . . . enough said.

When you play the music you will immediately be reminded of our old hi-fi friend Edgar Varese and his "Ionisation"—this is a sort of feminine counterpart, minus the furious energy, the superb rhythm, the furiousity of Varese. Twangs, mumbling voices, gongs, cat's squalls, weird sirens, above all a lot of mandolin-like pluckings that sound, for all their fancy designations, like what they essentially are, strings stretched over boxes. Eerie.

Conclusion? Yes, you'll think this is cracked, as you probably did the Varese record (and many another experiment, including the John Cage Prepared Piano, Henry Cowell's tone clusters—he plays with his nose and reaches inside to pluck the strings, and is a much respected elder member of the musical community), Carillo's 16-tone 13th Sound Ensemble of Havana (old Columbia records)—and, of course, the newest of the new, Electronic tape music, now very much the latest rage.

Yes, all these Movements are cracked, more or less, and not one that I have heard so far has in itself much value as musical communication. Most are insufferably naive, often almost illiterate in any true musical sense. Yet, in the way of revolutions each undoubtedly has something underneath of good—once we can put aside the fanaticism and make use of the new kinds of raw material. There are interesting tone colors here, a good sense of rhythmic counterpoint, the interchange of rhythms from one instrument to another.



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So it is in most avante garde stuff. We'll just have to accept the fuss, the show, the cult, as somehow a necessity in our age, smile upon it a bit indulgently, listen for new sounds and then attach our own moderate evaluation thereto—not those of the fanatic proponents.

Incidentally, this disc has on it the lowest recorded tone I've ever heard—I thought it was turntable rumble until I discovered it was something being struck, like a very low-pitched Chinese gong. 20 cps, maybe. Interesting.

Ultimate touch: the disc is made of bright green plastic. Anything to be different. And it says PLAY BY MANUAL CONTROL ONLY. No mere changers for this special-special record.

**Cook "N-A" Beam Test Record, Series 50.**

This is a unique and ingenious test device, no doubt already a familiar disc to many audiophiles but well worth signalizing for those non-engineers who haven't heard of it—even though for many an amateur the "no-good" signal that may be reproduced from it will be merely a disturbing indication of a negative sort, saying only that something is wrong—somewhere.

The device used here comes as near a factual and objective analysis of distortion as would seem possible via the ear (without meters or other visual measuring methods); yet—and this is one reason I mention it—there are still traps for the unwary musician. Let me explain the system for those who are strictly non-engineers.

Cross modulation (similar to intermodulation or IM) is simply the generation of sum-and-difference tones, more popularly understood as "beats" when any two exciting tones are sounded at once. There's lots of this naturally in music itself and other "original" noise, but it occurs, alas, also in our reproducing systems, adding new tones to those already present—distortions of the original sounds. That's an important distinction: "distorition" in the original sound is one thing, a change caused by the record-reproduce system is quite another.

Testing for distortion of this sort is done by choosing just two tones, pure ones generated electronically, for simplicity, then measuring the amount of difference-tone that is generated and added to the original by the component or system under test. One can actually see these additions on the scope. This, of course, is a kind of distortion quite separate from harmonic distortion, which can also be seen.

The cook "N-A" Beam record makes use of the device used in radio airways beam signals. There is, first, a pure-tone 1000-cps pilot signal of a fixed strength, not steady but in a code pattern, the dot-dash of the letter "A" (Fig. 1).


Fig. 1

Two other tones, sirening downward from ultrasonic regions to the 4000-cps region, are superimposed on this. As they descend, these two remain the same frequency distance apart—1000 cps. (Not the same musical interval since that is a numerical proportion.) Since the difference between them is constant at 1000 cps the difference-tone "beat" distortion in your system, if any, will itself remain constant at 1000 cps and can be heard at the same pitch as the "A" pilot tone.

To complete the arrangement the lower of these two siren tones is intermittently shut off, in the dash-dot "N" pattern, (Fig. 2) exactly filling up the spaces between the dot-dash "A". (When only one of the siren tones is on there can be no difference-tone "beat"; only when the two operate at once will the fixed-pitch "N" distortion show up, if any.)


Fig. 2



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So—if your equipment is good enough to create less than 2 per cent of this cross-modulation "beat" distortion, the "N" signal, fixed-pitch, will be inaudible or less loud than the "A" signal. If the two are the same in strength —2 per cent distortion—the two signals blend and there is a continuous tone, as in Fig. 3; if the distortion is higher than 2 per cent the "N" signal is the louder and you hear the "N" rhythm.

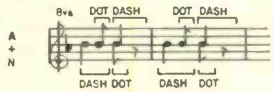


Fig. 3

Most ingenious, and it works, though of course the test is for the entire system from pickup through speaker and does not tell you where the trouble, if any, is occuring.

Now for the Canby musician's reaction. In the first place, a good musician will find it sometimes difficult to decide whether he hears the "A" rhythm or the "N" rhythm—in proportion to the state of finesse of his rhythmic sense. A good musical ear can pick out and "feel" either rhythm if both are present, even though the volume levels may be different. I have found myself disagreeing with someone else as to which was being "heard" at a given moment, since I could "hear" either one. Not important, for if the two sounds are so close to equality, the distortion is very close to 2 per cent. But, oddly enough, the wholly untrained ear is in a better position to be objective in this test than the trained one. Good!

There's another way out however for the musician that isn't specified by Cook. The ear's pitch sensitivity is greater than the accuracy of the two descending siren signals; the "N" resultant tone is actually not steady in pitch but varies above or below the fixed 1000 cps "A" sound, by a noticeable amount. I find that I can easily tell the "N" sound without even bothering with rhythm merely by its slightly wavering pitch, against the rock-steady pitch of the unmoving "A" tone.

Either way will work, and there's no doubt about the over-all value of this novel audible test. I've already tried it with three good cartridges, the rest of the system remaining fixed, and have noted considerable difference in the very high frequencies (ultrasonic) and down to around 13,000 between the three. The test does not go below 4000 cps.

The reverse side makes tricky use of the Cook Binaural double-pickup system; the two signals are separated there on two tracks for two pickups and if the two are fed into one amplifier the performance of the cartridges is by-passed and any distortion heard will be entirely from the amplifier-speaker section. No doubt there are other ingenious ways to put this versatile record to good testing use.

## SOUND HANDBOOK

(*from page 31*)

The necessity for good ventilation of electronic components is an additional reason for having a separate or at least structurally independent speaker enclosure.

Although audio components should not be allowed to rattle around freely in the cabinet, the method of anchoring should be such that any one unit can be removed for servicing with a minimum of trouble, and without requiring special tools or special procedures.

REFERENCES

Mark Vino, "Interconnection of audio components," *Service*, August, 1952, p. 20.
Mark Vino, "Physical mounting-layout of audio components," *Service*, September, 1952, p. 46.

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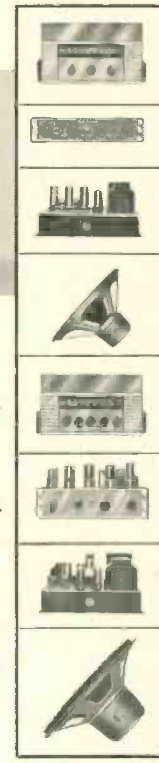

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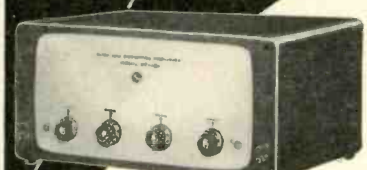

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# TOPS IN HI-FI POPS

ROBERT SYLVESTER

Two recent releases of Artie Shaw music—Artie being almost as controversial a Shaw as the late G. Bernard—pose a nice problem in listening. Offering music of sixteen years ago and music today, it's hard for the listener to determine which has undergone the greatest metamorphosis—the technique of recording music or the musical technique of Shaw.

One of these exhibits is Victor's two-platter, 12-in. LP which takes us back to Shaw's great days as a swing bandsman, the days of his orchestras in The Blue Room of the Hotel Lincoln and the Cafe Rouge of the Hotel Pennsylvania. All the great Shaw standards are here—*Begin The Beguine, Nightmare, My Reverie, Stardust, Sweet Sue, In The Mood*, and many others, twenty-four tunes in all.

All the great Shaw sidemen of the mid-1930's are at their jumpingest on these four sides. The hot saxophone of Georgie Auld soars out effortlessly and with driving spirit. Tony Pastor sings in his gravelly voice and Buddy Rich, greatest of the swing drummers, sets an overpowering beat and flies off on frantic solos. There is also, for the collector, a chorus by the young Billie Holiday, reminding us of a time before she was fully stylized and sang with a touch of romance instead of the veneer of despair which was to come with her own personal defeat.

It's all here, all right, all the great things of an era. But the over-all effect is disappointing and, compared to records made and played with modern techniques, these hits of yesteryear are almost amateurish in general sound accomplishment. The trouble with them is, probably, that they were originally air checks, recorded from Shaws' broadcasting sessions at the hotel rooms. Also, the dubbed-in applause sounds as if somebody did it as an afterthought and then tried to change his mind.

The other Shaw item is something different. It's his first release for Bell Records, a releasing outfit which sells records in bookstores rather than other marts. A Bell record looks about the size of a 45 but it is cut in standard 78 r.p.m. and, besides taking up less space in the record cabinet, is pliable and unbreakable.

For Bell, Shaw and his highly modern quintet do *That Old Feeling* and *Besame Mucho*. One wouldn't believe that the Shaw of *Feeling* and the Shaw of the old *Beguine* are the same musicians. With his modern group, he takes only a short riff with *Feeling* and seems content to be a part of an intensely knit and thoroughly disciplined "cool" ensemble. On *Besame Mucho* he comes closer to a solo against a jagged background beat. Here he performs a sort of exercise in dodging melody without ever straying too far away from it. All in all, the Bell exhibit is a crazy record, man, crazy!

### Les Baxter

The novelty of the moment is Les Baxter's album for Capitol (12-in., one side, LP) called, simply, *The Passions*. Baxter has established himself as one of the most highly imaginative and daring of the arrangers and with *Passions* he goes all out. The record details Despair, Ecstasy, Hate, Lust, Terror, Jealousy, and Joy according the gospel of Baxter and it features, beside tone poem music and a vocal chorus, the wailing of a girl named Bas Sheva.

In her more moody moments, Miss Sheva fairly tears herself thorax from larynx. And while doing so, you are invited to read verses from the Bible and from Shakespeare, no less. The whole idea gets a little frightening after a while.

### Jackie Gleason

Jackie Gleason, a comedian who is so busy leading his own studio ensemble that one wonders how and when he finds time to think up a joke, has another Capitol (12-in., single side, LP) exhibit, this one called *Tawny* in honor of the recent Gleason television ballet. (Yes, yes, Gleason can do ANYTHING!) One side is apparently a house band doing the ballet music which sounds like perfectly good ballet music but would, naturally enough, be improved if you could watch somebody dancing to it.

On the reverse side, Gleason has assembled all his trusty fiddles and cellos and stuck the brilliant Bobby Hackett up in front of them with his golden trumpet. As Hackett & Fiddles did on two or three previous occasions, six sentimental and not-too-well-known melodies are treated to the full strings, done slowly and carefully, while Hackett ad libs in and out with his singing horn. The echo chamber is again utilized and, while the gimmick is getting familiar, there is fine music and mood to *Little Girl, I Cover The Waterfront, Some Day* and *If I Had You*.

### Hillbilly Hymn

What will surely be the novelty of the month is a Coral release (8-in. 78) of two sides of *Make a Joyful Noise Unto The Lord*. And who sings this bit? Why, it is sung by four girls whose names are Jane Russell, Connie Haines, Beryl Davis, and Della Russell. That's right, I said JANE Russell, the brunette that gentlemen prefer. Jane and her sister churchwomen do the bit straight, taking turns at a real, regular, holy-rolling hillbilly hymn.

An accompanying press release states that this record is "remarkable . . . sensational . . . deeply spiritual . . . soul satis-



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fying." It is probably all these things. My fault with it is that the gals, well-meaning though they may be, all sound pretty much alike and that arranger Lyn Murray has them hustling too fast from start to finish. But it's an item that you'll want to hear if only because the gals are contributing their royalties to favorite church charities.

**Piano**

As might be expected, the supply of piano collections continues undiminished. MGM offers George Shearing (16 songs, single disc, LP) in *When Lights Are Low* and has shown the good sense to collect the recording Shearing did when he first came to fame and when he would rather play something exciting than sit at the piano and tell bad jokes. In these tunes—particularly *Indian Summer, I Didn't Know What Time It Was,* and *There's a Lull in My Life*—he reminds us of the days when he had a solid beat, new chording ideas, and a nice taste in what not to do with the bop form. This one is Shearing at his best.

MGM has also issued two solid keyboard men, each taking a side (12-in., LP) for six of their best pitches. Eddie Haywood, on one side, is best with *Memories of You* and *Stormy Weather.* Teddy Wilson, who showed many of the modern favorites how it should be done, rolls forth with first class versions of *Why Shouldn't I?* and his own *Sunny Morning.*

**Calypso**

Eartha Kitt, this season's wunderkind, has a new Victor single (78) with a hillbilly epic called *"Lovin' Spree"* backed by *"Somebody Bad Stole de Church Bell."* This latter is—deliver us!—one of those calypsos with a lyric consisting of approximately one line and a half repeated. And repeated. And repeated.

**Ballads**

Lou Monte on another Victor single (78) sings *The Darktown Strutters Ball* in Italian, for reasons best known to himself, and then a pleasant ballad called *I Know How You Feel.* Both with Hugo Winterhalter's fine, smart background. Phil Harris has a Victor single (45) of two novelties called *Take Your Girl to the Movies* and *I Know an Old Lady.* Neither has Phil's usual, comic and razzmatazz style, but both are amusing enough.

Frank Sinatra, also in a sentimental mood, has eight standards on a new Capitol LP accompanied by a small combo led by Nelson Riddle. Sinatra, the eminent actor, has never paid less attention to his phrasing and also hits a couple of inexcusable flats. The highly-arranged Sauter-Finnegan Orchestra comes up with a Victor single (78) which has Joe Mooney singing *Hit The Road to Dreamland* and a satire on old movie chase music called *Where's Ace?* Both should make the juke boxes without effort.

**PREDICTION:**

The year's most revived and experimented song will be the Richard Rodgers-Lorenz Hart *My Funny Valentine.* Various artists are experimenting with it on four current collections and innumerable others are fiddling with it for the future.


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| 375-0-375 | 120 | 5.0 | 3 | 6.3 CT | 4 | 4PHC-120 |
| 440-0-440 | 165 | 5.0 | 3 | 6.3 | 7.5 | 4PHC-165 |
| | | | | 6.3 | 3 | |
| | | | | 6.3 | 3 | |
| | | | | 6.3 | 0.6 | |
| 450-0-450 | 200 | 5.0 | 2 | 6.3 | 4 | 4PHC-200A |
| | | | | 6.3 | 4 | |
| | | | | 6.3 | 0.6 | |
| 550-370-75-0-75-370-550 | 300 | 5.0 | 6 | 6.3 CT | 5 | 4PHR-300 |
| | | | | 6.3 CT | 1 | |

**FILTER REACTORS**

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|---|---|---|---|---|
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| 2.0 | 70 | 240 | 2,500 | 4RH-270 |
| 2.0 | 120 | 105 | 2,500 | 4RH-2 20 |
| 2.0 | 165 | 80 | 2,500 | 4RH-2165 |
| 2.0 | 200 | 77 | 2,500 | 4RH-2200 |
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*Edward Tatnall Canby*

## Sines and Ceramics

I'M ABOUT TO EXAMINE a trend—not an unusual activity hereabouts. In this period of hi-fi's quickest expansion trends are trendier than ever—and more persistently overlooked than ever. How we love the present! Most of us think of the rosy future as just a Bigger Present, where business works just like now, only better. That isn't the way things go, as we ought to know. There are trends, changes, and this department at least is always prepared to throw in its 2 db worth of extrapolation as to what's coming next, and next after that.

I have in mind, for that matter, several closely related trends having to do with simplification, (a) cartridges, (b) recording and playback curves, (c) control functions. The latter two have been handily discussed by the editor in his January editorial (page 14) to which I hereby refer you. I'll stick mainly to the first and more specifically to the very embodiment of a trend to which I am at this very moment listening with some astonishment. The record I'm hearing is super-hi-fi, but not unusual in this day of super-sound. The playing equipment is of routine high quality with but one startling exception—the cartridge is the new low-priced Electro-Voice Ultra-Linear wide-range ceramic, described technically at length in the December issue. It feeds directly into a flat amplifier. No preamp. No tone control. No equalization. And yet its constant-amplitude response is within 2 db or so of the now popular New Orthophonic recording characteristic, which to all intents and purposes is constant amplitude.

And the sound is, to put it mildly, very impressive. I'll bet that nine-tenths of our readers, listening here, would never so much as suspect that I had other than one of the classic magnetics on the record. I'm not at all sure I'd want to try to pick out this cartridge in a blindfold test from a group of well known magnetics. This sound I'm hearing may be of top importance in the large hi-fi field.

### Sine Curve

There's a shapely sinusoidal aspect to the curves we might construct concerning cartridges, recording characteristics, control functions—but especially cartridges—over the years. The cartridge sine curve waves gracefully back and forth in a most interesting way, as we look back, in terms of two types of cartridge response, that of the magnetics (and the old acoustical reproducer) which operate on a constant-velocity basis and that of several kinds of cartridges, notably the crystal and now the ceramic, which are constant-amplitude devices. The response of these two types is basically different and vitally affects the reproduction of records—which also have varied in the cutting between these two.

Now every engineer-reader knows all about constant-amplitude and -velocity, but I'll wager that an awful lot of our not-so-engineers subscribers are in the perennial stew of confusion on this subject that was my state for untold years—or worse, in the state of blissful ignorance that precedes an inevitable rude awakening. This is not the moment to go into the difference, but if we are provoked, I expect that the editor and I can cook up an "Amateurs' Guide to Constant Amplitude/Velocity" for some later issue. Right now, I'll assume you can follow me, or can pick up a clue here and there as we proceed. The important thing to remember is that there are, in fact, two basic natural response or output curves for pickup cartridges (and for cutting heads similarly), before other factors even enter the picture. The difference is great—6 db per octave, a voltage-output ratio of no less than 2 to 1. That's what you run into when you change from a crystal to a magnetic, among other complications.

Anyhow . . . the sine curve of cartridge popularity fades in back in the acoustic days. The old cutting and playing equipment operated with what was basically constant velocity—not counting the whopping distortion and the vast top and bottom areas of no reproduction at all. Constant velocity continued to hold the field when electrical recording came in, for the magnetic cutter had that response and so did the earliest magnetic pickups, those two-ton terrors with the horseshoe magnets that we used to be so proud of. One compromise had to be made, though, which was of great significance. Constant velocity was fine for acoustic records because there wasn't any bass; but when electricity brought in the bass this type of cutting curve, allowing the amplitude to increase as the pitch went down, made for too-wide grooving. So, below a mid-point, there had to be the now-familiar decrease of bass, at 6 db per octave—constant-amplitude. However low the pitch went below this mid-point or cross-over, for a given input level the swings of the record groove got no wider.

That made the bottom half of the record constant amplitude while the top half remained constant velocity. The point of change was the famous turnover point. The loss in bass when the electrically recorded discs were played by magnetic pickups was made up for by bass boost, as now.

But soon there came a new development and the cartridge sine curve began a graceful sweep around a corner. The crystal cartridge, a constant-amplitude device, was introduced and gradually swept through the home phonograph field, eliminating virtually all of the magnetics. The crystal played



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the lower tones on the electric records correctly—but it drooped dismally on the upper part. However a complementary change in recording technique came along, the use of boosted highs (pre-emphasis) and thereby a vital new matching orientation of equipment was accomplished. The crystal's natural response gave a playback curve that was very close both to the bass roll-off, always present in records, and to the new boosted highs. Tip up the top of the curve, tip down the lower part, and you have a fine inclined plane more or less —close to the constant-amplitude characteristic.

Thus everybody was happy. Within the then acceptable frequency range the crystal played the average record "flat"—balanced as recorded, more or less. No equalization was necessary.

Most home phonographs and even the then "hi-fi" put-together systems used crystals in the thirties. In 1938 I bought a fancy Astatic model D cartridge and chrome arm (response up to 4000 cps), for the ultimate in home equipment, and was I proud! It played directly into the amplifier and my tone controls were used mainly to reduce distortion, to exaggerate the bass (for bass-shy speaker systems) and for matching room acoustics. I never heard of equalization and I didn't need to; there was little problem in the highs and the bass varied only in that European records usually had a lower turnover point and hence "more" bass (as heard) than ours.

#### Magnetics Again

But already at the height of the happy crystal era a new reverse section of our smooth sine curve was building up—magnetics again. They had been used right along in broadcasting; during the war we began to hear about improved new lightweight magnetics for the home, soon to come. Pickering was the first I knew of. Then, the war over, came the big boom in the new miniature magnetic pickups—and constant velocity took over again, ultra-low level, bringing new problems of preamplification and equalization to make the magnetic gadgets respond as the crystal did of its own accord.

But the magnetics took over, however, for the simplest and best of reasons—they gave and have continued to give unmatched audio quality. Why else! For that, we are willing to suffer along with preamplifiers and equalization, the dangers of hum pickup, noise, and assorted distortion, even the basically increased cost of this extra equipment needed for magnetic reproduction. After all, we want the best, every one of us. But just the same, the magnetic on its own remains vastly unmatched to present records, in both bass and treble, as many an uninformed beginner has found out the hard way. Its output must be thoroughly doctored to come out "flat." Minus the doctoring it plays the recorded preemphasis exactly as that, a ghastly screech, and it reproduces the bass droop of 6 db per octave with perfect fidelity! Nevertheless—we've come to depend on these constant-velocity midgets because they have given such superior sound, with the right doctoring.

Now it is plain for all to see that the modern recording curve is approaching more and more the true complement of the constant-amplitude phono cartridge, as the various extremes are toned down in the direction of moderation. The New Orthophonic is very likely to become an industry-wide standard now that it has been officially taken up by the various societies. It is indeed very close to the straight slope of constant amplitude. The famed turnover point is now no more than a slight hump


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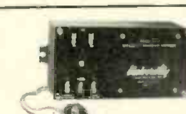

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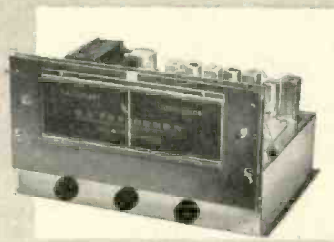

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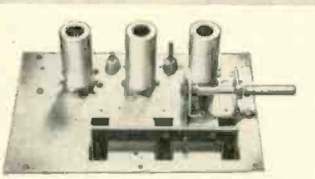

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in the line (left there, I gather, to facilitate electrical equalization circuits). We now go to extraordinary lengths to alter the natural response of our fine magnetics, creating artificially the very curve that nature gave directly to the crystal and its relatives. We've done miracles in making the required equipment practical and inexpensive and trustworthy, we've found the means to include good preamplifiers, good shielding, low distortion, and low noise levels even in our cheapest amplifiers and in many a home phonograph. But all this only because, in the end, the magnetic made possible better sound than ever before.

### Wide-Range Crystal

But the sine curve of cartridge usage was getting ready to swing again even as the postwar magnetic era entered its full development. In typical sine fashion the opposing forces were gathering strength. When LP came out in 1948 it was launched with a crystal. The first Columbia-Philco cartridge was no magnetic but rather a new miniature crystal quite extraordinary in every respect except, alas, response (which was nil above 6000 cps or so). But a replacement came soon after from Astatic, the model U cartridge, which had an excellent wide-range response easily beyond 10,000 cps. with surprising smoothness and, most important, a degree of compliance that, as I figure it, must have been significantly better than some of the very fancy magnetics of the day. (That cartridge tracked LP's when other systems couldn't seem to stay in the grooves, you'll remember.)

Here was a crystal that came close to matching the magnetic sound. But the trouble was that, first, it brought with it a new shape and size—"sugar lump" I called it—which was nonstardard for existing arms; and, worse, for wide-range use it needed a filter (to remove a peak at 9000 cps or so) which cost as much as a preamplifier for a GE cartridge. Impractical for general use, though it still is holding its own in the catalogues.

This and other new small crystals now made it suddenly clear that the old-fashioned heavyweight crystal, with its huge removable needle, its limited and distorted response, was definitely not to be the last word in the field. Crystals were catching up —and they continued to hold the trump card of automatic, preamplifierless matching of the record curve. Once the changeover to the new-type replaceable "permanent" needles was complete a large number of compromise small crystals appeared, to go into commercial machines, and here and there among the hundreds, wide-range response began to appear as a definite sales point.

The crystal was in general still far from a hi-fi unit, alas. Most were terrible in any decent hi-fi surroundings though suitable for rugged commercial use. But the model U was being used for hi-fi FM broadcast. The CQ cartridge brought good wide-range quality in a new small case that included the standard half-inch mounting holes to fit any arm—and no filter needed for it. The CAC crystal, extensively written up in these columns, took over the CQ's shell and became the first really practical wide-range all-purpose crystal that could begin to compete with the magnetics in that big essential—quality sound.

As I listen retrospectively in my mind's ear I'm inclined to think that the CAC wasn't really as good in the sound as the earlier model U. But it was far more practical and achieved a far greater "circulation," notably in the Columbia LP players. And it was for the first time deliberately offered with "internal equalization" to match the (then) LP recording curve. No




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filter, no preamp, no equalization, and so it brought back the outward simplicity and convenience of the older crystals with most of the advantages of the magnetics. A lot of people made good use of it.

That was a few years back. The CAC still wasn't good enough. Few hi-fi addicts so much as looked it over and engineers in general stuck to their magnetic guns. I did too. Still do. It was just a question of which magnetic. Though the CAC (and perhaps several contemporary crystals of the sort) was plainly far ahead of earlier crystals, though it was good enough to rate as wide-range and even as hi-fi—it still wasn't really up to the quality of the magnetics. Otherwise we all would have long since converted to crystals. And besides, everybody knew that crystals were sensitive to heat and moisture and broke easily. (I know one user who has had three CAC's break under normal usage in a changer.) No—the crystal was inherently not good enough. Moreover there was much talk of the typical "crystal sound"—possibly an unscientific way of describing response, but it made sense. I know the sound only too well—a kind of metallic ringing tone, a species of distortion that, the ear says, must be due to nonlinearity along the response curve. The old crystals had it so bad that there was a definite "phonograph sound" that we used to blame generally on the whole phonograph system. Records always sounded that way. Especially with male singers. Remember? So the crystal was out, for hi-fi tops.

### Ceramic

Put aside for now a whole batch of assorted special pickups, some long since defunct, others very much alive at the moment. None has yet shown signs of big-scale importance. The ceramic cartridge is the postwar innovation that eventually has taken us beyond the crystal's ultimate stalling point. But the early ceramics had all the physical virtues you could ask for —and no tone quality worth mentioning. You could bake them, wet, freeze, boil them without harm or change in response. But they didn't sound very nice. I tried some.

The first ceramic that, at last, began to catch up with the crystal in sound quality came only a year or so ago with the Columbia 360 phonograph, the Sonotone ceramic that is now separately available and quite widely used (See Æ, March 1953, page 46.) I've heard more of that cartridge since then; I suspect that careful listening tests might rate it at about the same sound quality as the CAC; excellent, but still not quite up to magnetic sound. (Competition is of course most directly with the low-priced GE magnetic cartridges.) The newly practical feature of the Sonotone was the highly ingenious turnaround double stylus, two points at one end of one shank, making the complete turning over of the cartridge unnecessary. Almost instantaneous replacement of the stylus assembly goes with this and is decidedly appreciated—a physical advantage over any other cartridge of any sort.

If we started impartially from scratch right now, threw out all present equipment and designed new equipment, the Sonotone-type ceramic would at once be a formidable power in competition with the magnetics. A shade less good quality of sound, and that for many of us makes a very big difference, admittedly. But we must recognize that for countless other listeners the difference would seem slight or nonexistent, especially in systems where other elements are of less than top quality. The Sonotone-CAC type of sound still, in good equipment, is far superior to any normal commercial



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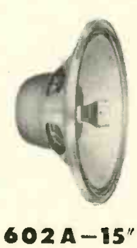

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sound of a few years back. Indeed, it's clear that the development of the new commercial "hi-fi" machines would have been quite impossible without the greatly improved ratio between sound quality and cost that came with these wide-range ceramics. Here the magnetics are at a painful cost disadvantage.

### Better Mousetrap

Perhaps you can see the picture as I see it. The magnetics reign supreme now in hi-fi and even in a good deal of medium-fi, on two bases. (1) They do produce, as of this moment, better sound quality than the ceramic competition. But the margin has been getting smaller and smaller. (2) The vast bulk of available equipment is now manufactured to make magnetics; the industrial problems presented by the preamplifier and equalization have been met, and virtually all presently made equipment is designed for them. Indeed, to go a step further, the very deficiencies of the magnetic have been turned into cash—in the enormous expansion of equalizing and tone control devices that have been launched this last year or so.

But that is strictly the short-sighted view. Things will change. The public will always go for what can be shown as a better and above all a simpler mouse trap.

There are very decided signs right now that we've gone too far with all this fancy control stuff. Lots of people will take it with delight, but a still wider audience for recorded sound exists which just as definitely will have none of it. Simplification is on the books. The ceramic is simple in the most obvious and useful ways. No preamp, no equalization, no hum pickup etc etc. With the sound quality margin between ceramic and magnetic so slight, it is clearly only a matter of time before the equipment market itself begins to veer around the great sine corner—for equipment does change, and in terms of those short years we live in, it changes fast. How long did it take the hi-fi business to equip its entire output of amplifiers with compensated preamplifiers?

Remember the early GE separate preamp—manufactured as an extra because nobody had any built-in preamps? There is no theoretical reason why the reverse process might not be just as rapid, though the slogans may be different. And remember that if anyone wants them, equalization curves can be set up for ceramics too. It's just that really, honestly, there aren't going to be very necessary—soon.

### Now—the Ultra-Linear Ceramic?

There, for your inspection, is the dynamic, fast-changing background for the new cartridge to which I was listening at the head of this column, the Electro-Voice Model 84 Ultra-Linear ceramic. This cartridge takes things forward still one more step—and there isn't much further to go. It is a single model—no double stylus arrangement, but even so it is an innovation of plenty profound significance along the developing sine curve. It's good—very good. It has all the basic advantages we've seen already, plus even better-quality sound—quality that cannot be far removed, both by my ear's dictum and by the published specs, from that of the competing magnetics. Moreover its published description claims factors of compliance, lateral and vertical, low vertical pickup, wide range (flat at least to 15,000 cps) that may well approach the offerings of some magnetics in the same respects. (It has all the commonly expected features such as replaceable stylus, diamond or sapphire, slip-on rear connections, half-inch mounting holes and so on.) Above all, to my ear this cartridge does *not* have that tell-tale "crystal" sound, where in both CAC and Sonotone, as of last year, I thought I could still detect it. That denotes a new cleanness of response.

Now get me straight—I'm not really sure whether this EV Model 84 can actually and literally stand up against a battery of high-quality magnetics and hold its own. I haven't tried. At worst, there is a difference which will keep the most critical ears well away from Model 84. At best, they won't be able to tell which is which. I haven't tried. But even at worst, we have an important step and perhaps a crucial one. At worst, as I see it, this type of ceramic can easily fit into a vast number of quality home music systems of the more modest sort, quite aside from the commercial type machines which may use it. At worst its quality would still be adequate for a large number of installations now using inexpensive magnetics.

### Millennium?

If this is true, then—the millennium! (Millennia used to come one in a thousand years; nowadays we're lucky if they hold off a few months.) For if a ceramic can equal a magnetic for most purposes at the same cost or less, then there are vast number of magnetics that are now running on sheer inertia! Their preamps are paid-up and working well—but what happens when a replacement is due?

If a low-cost ceramic can replace an equivalent magnetic cartridge in many installations, why continue to build preamplifiers and equalization? Why, when with ceramics the entire need for the vast and ingenious present accumulation of preamp and equalizing equipment is gone and a better, cheaper, simpler amplifier can be built for the same result?

It's only a matter of time, then—quite a


**35 POUNDS OF STUDIO QUALITY —ON REMOTES!**

**PORTABLE AMPLIFIER**

USE this sturdy, one-package amplifier on remotes or in the studio. Get added flexibility in both operations with four built-in pre-amps, high level mixing and master gain control.

- AC or battery operation banishes power failure problems.
- Minimizes hiss, hum and microphonics.
- "Woofing" no longer necessary. Unit includes a 400-cycle tone oscillator. An *original* G-E development.
- Daven step-type attenuators for mixing and master gain.

**PLUS** low level output with volume control, high gain cue circuit, and handy write-in strips for mixer marking.

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bit of time—before the first cheap, efficient, low-priced, preamplifierless hi-fi amplifiers (or control units) appear, designed specifically *not* to take magnetics. The sine curve will then be near the end of its latest swing.

Wishful thinking? We shall see. Personally, I intend to hang onto my magnetics for a long time to come, since I don't expect any thing better, unless in the expensive class. But hi-fi and audio are moving into big new areas now where "compromise" of a sort that brings the best possible quality in the simplest possible manner is more and more important. I'm not the one to tell you whether ceramics are for *your* personal ear. But if you're curious, get hold of an EV 84 (82 for 78 records) and put it into your own system. You'll find it interesting.

## AUDIOLOGY

(*from page 12*)

200 volts, in damped sinusoidal fashion with an effective time duration of about one-half cycle at the resonant frequency of $L$ and $C$. An amplifier rated at 10 watts with a 300-volt supply would be rated at only about 4 watts with B+ reduced to 200 volts. Thus when a relatively large signal is suddenly applied, a 10-watt amplifier with such a filter and change in load current momentarily becomes only a 4-watt amplifier, possibly with resulting overload and "rough" sounding leading edge of the reproduced waveform.

From Eq. (*1*) it may be seen that the higher the $R_L$ represented by changing load (i. e., the less the change in plate current), the lower the series $L$ and the higher the shunt $C$, the less will be the fractional transient dip. Obviously the trouble is inclined to be worse with amplifiers having more highly biased (AB or B) classes of operation, in which small idling plate current is followed by large current demands when signal is applied.

Before high-capacitance filter capacitors were available at low cost, it was customary to minimize filter cost for given ripple reduction by employing a large filter choke. This of course is still done in equipment where electrolytic capacitors are considered unsuitable. In consideration of transient dip, $L$ would preferably be little larger than the so-called critical value for prevailing rectifier operation,[4] and the desired ripple-reduction factor produced with suitably large shunt $C$. Or, if rectifier operation permits the use of a capacitor-input filter, one may practically eliminate transient dip by simply omitting the choke.

A side-effect of transient dip, especially during the "ringing" period of a relatively undamped $L$–$C$ filter section, is amplitude modulation of the signal being amplified, due to the gain varying as a function of the supply voltage. However, the negative feedback probably in use for other reasons stabilizes the gain sufficiently to make this effect too small for detection by listening.

[4]Langford-Smith, "Radiotron Designer's Handbook," Fourth Edition, p. 1182.

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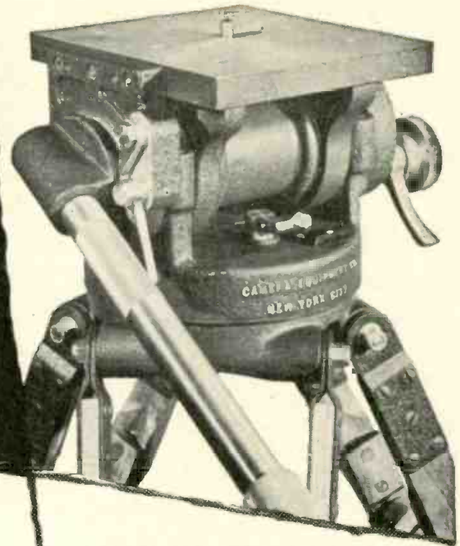
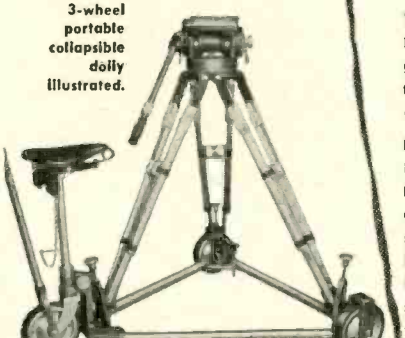
the NEW
"BALANCED"
TV Tripod
is doing a
whale of a job
every day!





"BALANCED" TV TRIPOD mounted on 3-wheel portable collapsible dolly illustrated.

We THREW THE book away and engineered a brand new "BALANCED" Tripod for every photographic and video need. The result—a revelation in effortless operation, super-smooth tilt and 360° pan action.

PERFECT BALANCE prevents mishap if the lock lever is not applied. Quick release pan handle locks into desired position. Mechanism is enclosed, rustproof, needs no lubrication. Tension adjustment for Camera Man's preference. Built-in spirit level. Telescoping extension pan handle. We defy you to get anything but the smoothest, most efficient operation out of this tripod beauty.

WE CALIBRATE LENSES . . . Precision "T" STOP CALIBRATION of all type lenses, any focal length. Our method is approved by Motion Picture Industry and Standard Committee of SMPTE. Lenses coated for photography. Special TV coating.

WE DESIGN and manufacture Lens Mounts and camera equipment for 16mm — 35mm and TV cameras.

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Wide frequency range 30 cps to 20 kc
Low distortion
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Engineers and musicians now realize a perfect transient response of any recording system is of paramount importance — the Grampian cutterhead with its precision-made true balanced armature and flux correcting feedback loop obtains this ideal.

The Grampian is used by international radio net-works to guarantee Hi-Fidelity sound reproduction. You can achieve the same high quality results in your disc recording with the Grampian.

After testing and experimenting with all types of equipment many famous record manufacturers, such as CAPITOL RECORDS are converting to the Grampian Feedback Cutter for the best results.

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# NEW PRODUCTS

• **Loudspeaker Cabinet.** The "Fold-a-Flex," a new speaker enclosure for high-fidelity sound systems, recently introduced by Stephens Manufacturing Corporation, Culver City, Calif., incorporates characteristics of all three of the more popular types of speaker cabinets. Simple mechanical

adjustments are provided for making the enclosure into an infinite baffle, bass reflex, or a folded horn. Choice of the enclosure type is determined by the listener on the basis of room acoustics and his particular listening criteria. The new three-in-one cabinet contains three ports whose openings may be varied to achieve desired enclosure characteristics. Dimensions are 36" h x 38½" w x 17½" d.

• **High-Pass and Low-Pass Filter Set.** Many design and production functions will be eased by the new Model 1A high-pass and low-pass filter set recently introduced by Allison Laboratories, 14185 Skyline Drive, Puente, Calif. In the past similar filters for use at audio frequencies have been heavy and cumbersome, however, the 1A is but 14 x 7 x 5¼ ins. and weighs only 17 lbs. The set consists of two k-type sections of low-pass filter and two k-type sections of high-pass filter in a single case. Switching is done in octave steps with continuously-varaible multipliers to cover the range of each octave. The cut-off frequency of both the low- and high-pass filter is adjustable from 65 to 20,000 cps. Loss in the pass band is 1.5 db ± 1 db and the attenuation

outside the pass band increases at the rate of 30 db or more per octave. Maximum attenuation exceeds 90 db. Since the unit is a passive nework filter, no power supply is required. Additional information will be supplied on request to the manufacturer.

• **Long-Life Tape.** With a break strength two and one-half times as great as ordinary recording tape, the new "Lifetime" tape is expected to last indefinitely under ordinary conditions of handling and use. Due to a newly developed oxide coating and a base of DuPont "Mylar" polyester film, neither of which contains a plasticizer, "Lifetime" tape is one-third as strong as machine steel and will neither break nor stretch. The latter means that timing errors due to tape elongation cannot occur, a factor of prime importance for broadcast use. The tape is impervious to temperature and humidity effects and


is micro-polished for maximum high-frequency response. Reeves Soundcraft Corp., 10 East 52nd Street, New York 22, N. Y.

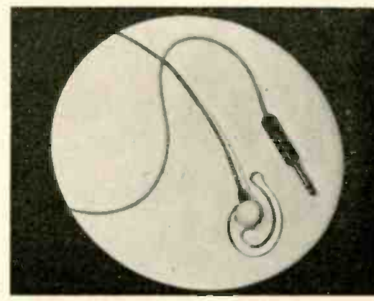
• **Message Repeater.** The Audio-Vendor, a new, automatic, message-repeating device embodying a magazine of magnetic tape greatly simplifies the use of recorded

commercial announcements. Built for continuous operation, the unit pulls the recorded tape from the center of the reel and automatically rewinds on the outside. The magazine fits any standard tape recorder. Announcements ranging from 15 seconds to 15 minutes may be repeated continuously; manual rewinding of the tape is not necessary. Free brochure describing the Audio-Vendor may be obtained by writing Cousino, Inc., 2307 Madison Ave., Toledo 2, Ohio.

• **Transistorized Microphone.** Designed primarily to improve the quality of voice communication between pilots and airport control towers, this new Remler development consists of a magnetic microphone or handset with a built-in transistor preamplifier. In operation it derives its power supply from the same sources as the carbon microphone it replaces, and as a result may be plugged directly into existing equipment. No rewiring is necessary. The unit suppresses extraneous noises and more than triples the range of the conventional carbon microphone to include voice frequencies from the lower part of the sixth through the ninth octave. Frying and hissing sounds which are typical of carbon-type microphones are absent in the device, and stability of performance is not

affected appreciably by rough usage or changes in altitude, temperature, and humidity. The unit is scheduled for immediate production. Remler Company, Ltd., San Francisco, Calif.

• **Tiny Single Earphone.** Weighing but one-half ounce, the Telex Earset is a single-phone headset which is held in



place by a flat plastic frame shaped in the form of a comma. A sensitive hearing-aid-type receiver is centered in the frame, while the "tail" of the comma slips over the ear to hold the assembly in place. The Earset can be used for radio and transcription monitoring, multiple listening, and other similar applications where a headset is required. Frequency response is from 50 to 4000 cps and comfortable listening is afforded with an input of three milliwatts. Literature and price information may be obtained from Dept. KP, Telex, Inc., Telex Park, St. Paul, Minn.

• **Hanging Corner Enclosure.** The Sound Corner is a folded-horn enclosure designed to be hung in a corner of the room about 13 inches from the ceiling. It employs the walls as two of three rigid boundaries, the

speaker baffle being the third. The edges of the baffle are lined with resilient material to simplify snug fit against the walls. The speakers are the LP 215 woofer and a direct-radiator tweeter, the LP 65. Frequency response is smooth from 31 to 16,000 cps. The new speaker system is called the Lorenz SCL Sound Corner and information is available from Kingdom Products, Ltd., 23 Park Place, New York 7, N. Y.

• **Coaxial Speaker Assembly.** Adaptability of the Bozak speaker system is greatly improved with the introduction of the new Model B-207 in which the woofer and tweeters, together with crossover filter, are all mounted on a 15-in.-square plywood panel which may be placed in conventional



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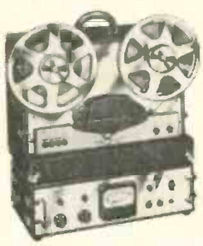
## REK-O-KUT
### 12-inch, 3-Speed TURNTABLES
### Model L-743

A broadcast quality turntable designed for discriminating users . . . professionals and audiophiles. Driven by 4-pole motor. Turntable itself is made of cast aluminum, and exerts no pull on magnetic cartridges. It is precision machined with a heavy rim for dynamically balanced flywheel action.

A single knob permits instantaneous selection of any record speed: 33⅓, 45, or 78 rpm. Record slippage is eliminated through use of new mat material. There is virtually no rumble, wow or flutter. Complete with 45 rpm record adapter ........ **$59.50**

**Model T-12H** A DeLuxe version of the above for the ultimate in turntable design for 33⅓ and 78 rpm only. Driven by constant speed hysteresis synchronous motor ........ **$119.50**

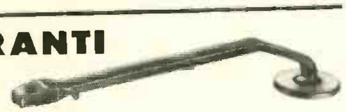
## MAGNECORD
### *PROFESSIONAL* TAPE RECORDER
### M80 Series



Provides full range response: 30 to 15,000 cycles at 7½ inches/sec., and 30 to 20,000 cycles at 15 inches/sec. Has new, slot-loading feature, and automatic tape lifter. After loading, all operations are pushbutton control. Starts and stops within 1/10 second. Accommodates 10½ inch reels. Flutter and wow are less than .1% at 15 inches/sec. Employs high quality, low noise amplifiers with direct-coupled cascode input stages. Can be adapted for remote operation.

| | |
|---|---|
| **M80-ACX** chassis only for rack mounting | **$1185.00** |
| **M80-AC** portable, with cases | 1265.00 |
| **M80-ACC** console complete with cabinet | 1345.00 |

## The FERRANTI RIBBON PICKUP



Designed by D. T. N. Williamson, this new pickup represents years of study and development. It is a complete unit of pickup head and arm with the head interchangeable for either standard or microgroove records.

Frequency response is uniform to 20,000 cycles with output provided to 100 kc. Only 3 grams stylus pressure. Mechanical resonance has been kept to 3 cycles, well below the recording range. Greater than normal compliance promotes uniform response and minimizes record wear. Both heads employ diamond styli with an elliptical stylus used for standard groove records. When used with appropriate transformer, output is 20 mv into 100,000 ohms.

**Ferranti Pickup** with arm and transformer ........ **$76.95**
Specify standard or microgroove.

**Extra Head** (standard or microgroove) ........ **37.50**

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**If you want to See and Hear the finest . . . the widest selection of high fidelity equipment . . . be sure to visit the HARVEY AUDIOtorium. It will thrill you.**

**NOTE: Prices Net, F.O.B., N.Y.C. Subject to change without notice.**

## The SCOTT
### 99-A TRANSCRIPTION AMPLIFIER

A complete, self contained preamplifier-equalizer and 10 watt power amplifier with built-in power supply. Input switch permits selection of desired channel: phono, tuner, tape, or other program source. Phono input has provision for magnetic and crystal, or constant amplitude cartridges. Equalization controls provide 3 turn-over and 3 roll-off positions, giving a total of 9 different curves. A rumble filter cuts off below 20 cycles at 24 db per octave. Individual, continuously variable, bass and treble controls provide wide range boost and attenuation. Loudness control automatically compensates for low level aural characteristics.

Power amplifier section furnishes 10 watts with less than .8% harmonic distortion. Frequency response is flat from 20 to 30,000 cycles. Deliberate cut-off of higher frequencies avoids possible ultrasonic oscillation and distortion.

**Complete with tubes** ........ **$99.95**
**Escutcheon** for Panel Mounting ........ 4.95

## The SCOTT
### 121-A *Dynaural* PREAMPLIFIER EQUALIZER

A complete self powered control unit providing equalization for all recording characteristics, independent bass and treble compensation, and noise suppression. Eight input channels permit use with microphone, tuner, phono pickup, tape, and other program sources. Separate screwdriver controls enable balancing of input levels. Turn-over frequency control is continuously variable from 250 to 800 cycles. Roll-off control range is from 0 to −22 db at 10,000 cycles. Frequency response is flat from 19 to 35,000 cycles, with deliberate cut-off of higher frequencies to prevent ultrasonic oscillation and distortion. A rumble filter cuts off below 20 cycles at the rate of 24 db per octave. Individual, continuously variable, bass and treble controls permit boost and attenuation at both frequency extremes. Loudness control compensates for all characteristics at different levels. Disabling switch introduces conventional volume control.

Dynaural noise suppressor automatically cuts out record and rumble noise in proportion to signal-to-noise ratio. Degree of suppression is continuously adjustable. Other features include: low pass filter with sharp cut-offs at 6, 12, and 20 kc . . . cathode follower output permitting up to 70 feet of cable to main amplifier . . . additional output for recorder.

**Complete with tubes** in metal cabinet for panel- or rack-mounting ........ **$157.75**
**Same as above** but covered with top grain, hand tooled cowhide **162.75**

## *The* NEW ELECTRO-VOICE REGENCY
### SPEAKER SYSTEMS

The **Regency** is a Klipsch-licensed corner horn enclosure, suitable for either corner or flat wall location. Superlatively styled in lowboy design, the Regency is available in either hand-rubbed mahogany or blonde Korina, and may be used with single 15" speakers, two-way, or three-way systems.

The **Regency II** consists of the Regency enclosure together with the EV 114A two-way system composed of a 15W-1 LF driver, an X-8 800 cycle crossover network, and a T-25 25 watt treble driver with 8-HD Hoodwin diffraction horn. The **Regency III** consists of the Regency enclosure together with the EV 114B three-way system, composed of a 15W-1 LF driver, an X-8 800 cycle crossover network, a T-25 treble driver with 8-HD Hoodwin diffraction horn, an X-36 3600 cycle crossover network, and a T-35 Super Sonax VHF driver.

| | | |
|---|---|---|
| **REGENCY** (enclosure only) | Mahogany | **$120.00** |
| | Blonde Korina | **129.00** |
| **REGENCY II** with 2-Way System | Mahogany | **310.20** |
| | Blonde Korina | **319.20** |
| **REGENCY III** with 3-Way System | Mahogany | **355.20** |
| | Blonde Korina | **364.20** |

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NEW WILLIAMSON TYPE

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# AMPLIFIER KIT

FEATURES

- Practically distortionless. Harmonic and intermodulation distortion both less than one half of 1% at 5 watts.
- Frequency response ±1 db from 10 cycles to 100 kilocycles.
- Altec Lansing PEERLESS or ACROSOUND transformers available.
- First Williamson type Amplifier supplied with matching preamplifier.

When selecting an amplifier for the heart of a fine high-fidelity audio system, investigate the outstanding advantages offered by the Heathkit Williamson type Amplifier. Here is an amplifier that meets every high-fidelity audio requirement and makes listening to recorded music a thrilling new experience through naturally clear, lifelike reproduction of sound at all tonal levels. Wide acceptance of the Heathkit Williamson type Amplifier by the most critical purchasers clearly demonstrates that high-fidelity can be coupled with low cost. For factual information regarding the Heathkit Williamson type Amplifier, consult "CONSUMERS RESEARCH ANNUAL CUMULATIVE BULLETIN 1952-53."

This outstanding amplifier is offered with the optional choice of the ACROSOUND output transformer or the PEERLESS output transformer. ACROSOUND features ULTRA-LINEAR circuitry, which is the exclusive development of the Acro Products Company and provides a greater margin of reserve power efficiency and increases power output. PEERLESS features additional primary taps to permit the optional choice of either the extended power circuitry, now enjoying current popularity, or all of the advantages of the original Williamson type circuit.

The construction manual has been simplified to the point where even the complete novice can successfully construct the amplifier without difficulty. Write for a free catalogue containing complete specifications and schematics of the Heathkit Williamson type Amplifier.

PRICES OF VARIOUS COMBINATIONS

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| W-2 Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. Shipped express only. | $69.50 |
| W-2M Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only. | $49.75 |
| W-3 Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. Shipped express only. | $69.50 |
| W-3M Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only. | $49.75 |
| WA-P1 Preamplifier Kit only. Shipping Weight 7 lbs. Shipped express or parcel post. | $19.75 |

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- tracks both Binaural and standard LP's
- adaptable to standard arms AND CHANGERS

*only* **$5.95**

- *In stock at your dealers*

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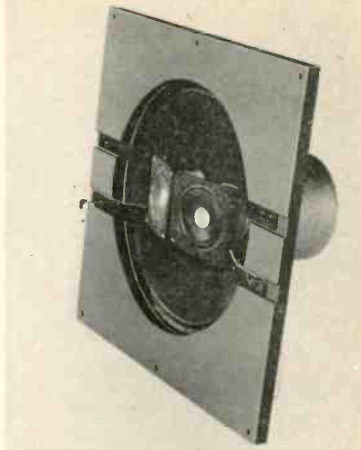
**COOK LABORATORIES** 114 MANHATTAN ST. STAMFORD, CONN.



fashion behind a cut-out for standard 12- and 15-in. speakers. Thus the entire assembly may be used to replace standard speakers without the need for altering existing cabinetry. Resonance of the woofer is below 40 cps. Response of the dual tweeter extends to 20 kc with spatial dstribution of 120 deg. at 10 kc. Specification sheet covering the B-207 is available on request from the R. T. Bozak Company, 114 Manhattan St., Stamford, Conn.

● **Central-Control Dual-Channel Sound System.** Flexibility is the keynote of the new Rauland Model S260 sound system designed for school and institutional use. Capable of feeding up to 160 rooms, the system offers a choice of two programs with simultaneous two-way intercommunication between any room and the

central control. Facilities are provided for selecting any two of six microphones and mixing them as desired, or with program material. Two FM-AM tuners are supplied as well as a transcription player which handles records of all sizes and speeds. Record changer and tape recorder are available optionally. Full descriptive details will be mailed free by Rauland-Borg Corporation, 3515 W. Addison St., Chicago 18, Ill.

● **Tape Splicer.** Conveniently small and formed of plastic, the Cousino tape splicer is provided with an adhesive back which greatly facilitates mounting of the unit on

a recorder or work table. After removal of protective coating the splicer may be mounted permanently wherever desired merely by the application of gentle pressure. Splicing procedure is identical with that of conventional metal splicers. Manufactured by Cousino, Inc., 2307 Madison Ave., Toledo 2, Ohio.



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# NEW LITERATURE

• **Minnesota Mining and Manufacturing Co.,** 900 Fauquier St., St. Paul 6, Minn., offers an interesting paper on the problems of tape recorder head alignment and head wear in "Sound Talk" Bulletin No. 27. The three-page discussion covers azimuth alignment and tape skewing, importance of head contact, and the effects of head wear on recording and reproduction. Also included is an eight-step check list for locating high-frequency response loss caused by head problems. Available on request.

• **Jensen Manufacturing Company,** 6601 S. Laramie Ave., Chicago 38, Ill., has completed a six-page three-color folder describing the new "Duette" two-way speaker system as well as the "Duette" portable unit. Technical and practical information regarding the two models is included in the pocket-size folder which is available to dealers and distributors without cost.

• **Chicago Standard Transformer Corporation, Standard Division,** Addison and Elston, Chicago 18, Ill., in Bulletin 479 describes the construction of the new Stancor ultra-linear high-fidelity amplifier. Photographs, chassis drawings, schematics, and parts list are shown. Frequency response of the amplifier is flat to 40,000 cps at output levels up to 20 watts. Harmonic distortion is less than one per cent at 25 watts; intermodulation is three per cent at 28 watts. Owners of the original Stancor-Williamson amplifier can convert to ultra-linear operation by installing the new Stancor Model A-8072 output transformer. Conversion data is included in Bulletin 479 which will be mailed free on request.

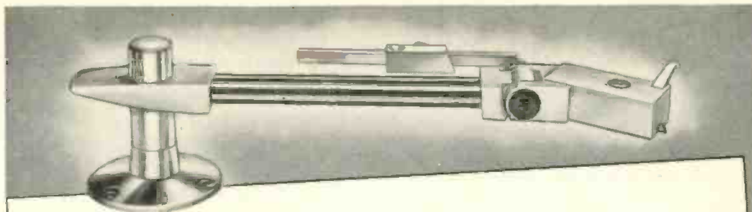
• **David Bogen Co., Inc.,** 29 Ninth Ave., New York 14, N. Y., in a handy pocket-size folder, pictures and describes its complete line of high-fidelity components. Included are recommended loudspeakers for use with Bogen tuners and amplifiers. All listings include prices. Copy will be mailed free on request. Specify Catalog HF154.

• **P. R. Mallory & Co., Inc., Resistor Division,** Frankfort, Ind., serves the needs of equipment design engineers in a handsome new catalog devoted exclusively to carbon and wire-wound potentiometers and rheostats. Especially interesting is the portion of the catalog which tells engineers how to specify control requirements to facilitate quotation and sample preparation and to assure speedy production. Presented are concise, yet complete, data to assist an engineer in selecting controls for any equipment under consideration. Requests for this excellent publication should specify Form No. 79-7.

• **National Scientific Laboratories, Inc.,** 2010 Massachusetts Ave., N. W., Washington 6, D. C. recently announced a Transistor Research Bulletin which will be published bi-monthly on a subscription basis. Primary objective of the Bulletin is to keep readers informed in the field of transistors, diodes, and other solid state devices. Editor is Michael C. Ellison. If the copy submitted to this column may be regarded as a criterion, design engineers should waste no time in having their names placed on the subscription list. The publishers did not indicate whether subscriptions are complimentary or whether a charge is involved.

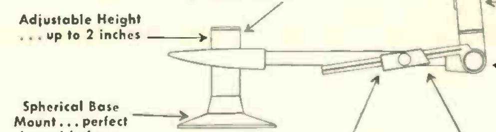
• **The Radio Club of America, Inc.,** 11 W. 42nd St., New York 36, N. Y., has recently published the first complete paper to cover the subject of FM multiplexing as introduced to the industry last October by the late Maj. E. H. Armstrong. Details of the system as it applies to both transmitters and receivers are described in Vol. 30, No. 3 of the Club's Proceedings under the title, "Some Recent Developments in the Multiplexed Transmission of Frequency Modulated Broadcast Signals," by Maj. Armstrong and John H. Bose. Requests for copy must be accompanied by a remittance of fifty cents.

• **James B. Lansing Sound, Inc.,** 2439 Fletcher Drive, Los Angeles 26, Calif., has issued a step-by-step construction folder covering the firm's rear-loaded folded-horn corner speaker enclosure. Published primarily for amateurs and experimenters, the four-page booklet is well-illustrated with photographs and dimensional drawings which cover cabinet construction from raw material to final assembly. Designated Catalog No. 34, the folder is available direct or through Lansing factory representatives.

Presenting
HIGH FIDELITY'S MOST REVOLUTIONARY
"Baton"

NEW! TONE ARMS




First the General Electric variable reluctance cartridge and now this G-E "Baton" tone arm ... two of the most important contributions toward improving high-fidelity reproduction in many years. The advanced tone arm design sets new standards of performance ... places new emphasis on pickup balance with no perceptible torsional resonance.

*Friction-free bearings* minimize groove wall damage ... provide welcome assurance of *even stylus wear!* Used in your system ... tone arm bass distortion disappears ... you'll enjoy ideal response from 20 cycles up! Examine all of its features. Here is the one tone arm you should own! Available in both 12" and in 16" transcription sizes.

* * *

**Order Your G-E "Baton" Tone Arm Today!** Local Dealers can now supply them. Or, write us, for literature and additional information: *General Electric Company, Section R4434, Electronics Park, Syracuse, N. Y.*

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CROWNING ACHIEVEMENT IN LISTENING PLEASURE

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CLASS A-1
WILLIAMSON CIRCUITRY
SUPRA-LINEAR

30 Watt Amplifier

It's new! There's nothing like it. It's the very finest quality amplifier combining every desirable feature: high power, versatility, minimum distortion, and the lowest cost ever.

**COMPARE:** *Ultra compact, precision crafted throughout, with polished chromium chassis. Plug-in electrolytic condenser, terminal board for all circuit components, sealed multi-section grain oriented output transformer, KT-66 output tubes. Frequency response 10 to 100,000 cycles ± 1 db; intermodulation distortion at 15 watts 0.15%; hum and noise level 96 db below full output; preamp power.*

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## MAGNETIC TAPE PROBLEMS

*(from page 21)*

### The Role of Dust

The importance of dust and dirt on tapes was at first underestimated because it was believed that the wiping action of the heads would remove much of it. Once the coincidence detector had been developed so that stopping of the tape mechanism permitted easy examination of a small local zone of the tape, it was discovered that stopping was frequently caused by dust and dirt particles rather than by actual defects on the tape.

How appalling this situation was can be realized by considering early total counts for 6 channels of nearly 1000 per 900-foot reel of tape and the fact that the computer cannot miss one pulse during normal operation without creating an error.

Installation of the lens tissue wiping pads over which the tape gently glided during reading operations reduced the count by about 60 per cent. Since dust might have interfered with the original writing operation the tapes were erased and rewritten; the counts, repeatable consistently, then fell to about 200 for the same tape. Removal of the wiping pads for a few moments raised the count by 20 to 30 per cent.

While these investigations were in progress, active interest and cooperation of a number of tape manufacturers was obtained. Tapes in recent months show counts running from 3 or 4 to about a dozen per 1000-foot roll, using the 6-channel coincidence detector. The reduction in count also reflects efforts to keep dust from the tapes. Not only were wiper pads used to remove dust which had reached tape surfaces, but tapes were kept in metal cans, the tape mechanisms were provided with dust covers completely enclosing all the tape and caution was used in handling tapes. Greasy hands can coat tapes with a small amount of oil which later accumulates dust. Gloves with as little lint as possible were used until personnel handling tapes learned to let the mechanisms do most of the actual moving of tape and touched it only with very clean hands.

In an atmosphere with very low relative humidity the tapes tend to become electrically charged and hence to collect dust. Air conditioning was a great assistance in this respect, probably because filtering of the air removed considerable dust. Efforts at lubrication of tapes to minimize static charge have not proven very effective and wire brushes and other devices have given conflicting results.

However, with some degree of humidity control and the use of dust covers and wiping pads, together with care in handling tapes and storing them, the dust menace has been largely eliminated. All the precautions are vital, however, and must be maintained.

### What about Remaining Defects?

The tape manufacturers have succeeded in ridding their product of the chewing-gum type of defect, embedded metal particles, the deflated and dried bubbles, and many of the other defects. Clumps are the main cause of defects sufficiently large to cause drop-outs. The orange-peel roughness in the base material apparently results from too rapid evaporation of solvent during its preparation and tape manufacturers—now that they are cognizant of the demands of computer and telemetering service—are bending even greater efforts toward improving the quality of plastic tapes.

But such programs consume time, and while they give us a feeling of optimism for the future, do not allow us to use tapes containing defects.

In the Raytheon computer, information is written on the tape in blocks, each of which is about 2¾ in. long. Normally a free zone of about ⅜ in. is allowed between blocks.

Utilizing the detectors developed, it has been found possible to indicate on the tape the locations of defective areas. These indicators are picked up photoelectrically by the tape-marking apparatus which places the printed photo marks on the rear of the tape. These not only number the blocks consecutively along the tape, but also designate the beginning and end of each. On encountering an indicator designating a defective area, the tape printing equipment automatically allots spacing for the succeeding block so that the defective area is always left in a free zone between blocks. Thus, defects never are present within a designated block and all writing and playback operations may be undertaken with reasonable assurance that errors will not arise from pulse drop-outs. Precautions against dust must still be used since a grain of dust beneath the gap of a writing head may cause a number of pulses to be ineffective.

This procedure, on the whole, has been very effective. Together with Raytheon parallel-channel recording head assemblies, it has made possible relatively high pulse densities and effective use of tapes as storage media.

### The Future?

As has already been pointed out, tape manufacturers are now acquainted with the demands of computer service and are actively engaged in improving the quality of their products. The strides they have made in the past two years are striking and of inestimable value.

Not only are they attacking the problems of eliminating defects but also of improving the base material. Cellulose acetate suffers because of its absorption of moisture which affects its dimensional stability and tensile strength.

With techniques already developed and assurance of better magnetic media to come, full realization of the potentialities of magnetic tape memory devices is closer to our grasp. They are here to stay and to perform their tasks in the computer field.



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**Acknowledgement**

It is both a pleasure and a duty to acknowledge the painstaking dexterity of Dr. A. J. Devaud in the microscopic work on tapes, the suggestions of K. Rehler on circuits, and the rugged patience of J. Kent who made most of the tape measurements.

This work was undertaken as a part of Contract No. N70NR-38902 for the Office of Naval Research.

## PATENTS

(*from page 4*)

with fidelity at least as good as the Williamson circuit.

Another embodiment shown in the patent is the opposite of that shown in *Fig.* 2 in that positive compensating feedback is applied to the upper tube rather than negative to the lower. Any of the standard forms of inverse feedback for the amplifier as a whole may be taken from the output of this circuit. Mr. Coulter does not state the power-supply requirements but it seems than the necessary voltage would be higher than normal.

**Advice to Inventors**

We would like to acknowledge grateful receipt of a letter from Mr. T. L. Bowes, Assistant Secretary and Patent Counsel of Stromberg-Carlson, a firm of which you may have heard, and pass on the helpful information it contains.

In the January issue we talked about how independent inventors can avoid some of the pitfalls of rushing to a patent attorney with hundred-dollar bills in hand, and we said among other things that an inventor can protect himself to a good degree by detailing the invention on paper and mailing it to himself or a friend by registered post. If the envelope is retained unopened, we said, the date of registry is presumptive evidence of the date of conception.

Mr. Bowes points out that many attorneys consider this of doubtful value and that it is better to have each sheet of description, drawing, and photograph signed and dated by at least two witnesses who have read and understood the principles on which the invention is based. We certainly should have thought of this, since we have actually done it ourselves upon occasion, and we appreciate the letter.

However, it seems to us that such documents are still subject to changes in the form of erasures and additions after the witnessing, which might conceivably give rise to doubts about their authenticity as proof. We have in the past used a belt-and-suspenders technique which we think is pretty foolproof and goes as follows. First we type and draw all the material on translucent drawing vellum. Then we make whiteprints of these sheets by one of the standard diazo methods used in engineering departments, after which we have the *prints* signed and dated and mail them by registered post for safekeeping unopened.

The idea is (1) it is difficult or impossible to alter diazo whiteprints, (2) the witnesses' signatures and dates authenticate the prints just as much as they would originals, and (3) the registered mailing causes post-office markings to be placed across the envelope flap so that you have to be pretty ingenious to open and reseal it without leaving traces.

I dare anyone to challenge successfully the authenticity of documents of this kind containing evidence of conception!

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| Fundamental Resonance | 35 c/s |
| Flux Density | 17,500 gauss |
| Nett Weight | 18 lb. 4 ozs. 8·3 kg. |

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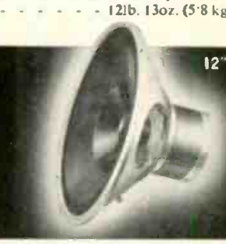



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|---|---|
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| Fundamental Resonance | 20 c/s |
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| Nett Weight | 9lb. 6oz. (4·2 kg.) |

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# VARIABLE LOW-PASS FILTER

(*from page 28*)

let us find what effect this 10 per cent variation will have on the value of $\zeta$.

(1) Tube gain variation

from

$$\zeta = \frac{1}{\sqrt{1 + K_2K_3}}$$

$$\frac{\partial\zeta}{\partial K_2} = \frac{-K_3}{2}(1 + K_2K_3)^{-3/2} = \frac{-\zeta K_3}{2(1 + K_2K_3)}$$

or

$$\frac{\partial\zeta}{\zeta} = \frac{-K_3\partial K_2}{2(1 + K_2K_3)}$$

and for

$$\left.\begin{array}{l} \partial K_2 \approx \Delta K_2 = 10\% \text{ of } K_2 = \dfrac{40}{10} = 4 \\ \text{and since} \\ 1 + K_2K_3 = 4 \end{array}\right\}$$

we have

$$\frac{\partial\zeta}{\zeta} = \frac{-3 \times 4}{40 \times 2 \times 4} \approx -4\% \qquad (13)$$

A 10 per cent decrease in tube gain will increase the value of $\zeta$ by 4 per cent, a negligible amount.

(2) Resistor variations.

From

$$\zeta = \frac{1}{\sqrt{1 + K_2K_3}}$$

again, and following the above reasoning, we have,

$$\frac{\partial\zeta}{\zeta} = \frac{-K_2\partial K_3}{2(1 + K_2K_3)} = 5\partial K_3 \qquad (14)$$

and for

$$\partial K_3 \approx \Delta K_3 = 10\% \text{ of } K_3 = \frac{3}{400}$$

we have

$$\frac{\partial\zeta}{\zeta} = \frac{-5 \times 3}{400} \approx -3.5\%$$

In making up $K_3$ therefore, 10 per cent resistors can be employed with no adverse effects on the value of $\zeta$.

(3) Tracking.

From Eq. (*7*),

$$\omega_n = \frac{\sqrt{1 + K_2K_3}}{\tau}$$

and

$$\frac{\partial\omega_n}{\partial\tau} = \frac{\sqrt{1 + K_2K_3}}{-T^2} = \frac{-\omega_n}{\tau}$$

therefore

$$\frac{\partial\omega_n}{\omega_n} = \frac{-\partial\tau}{\tau} = -\frac{C\partial R}{RC} = -\frac{\partial R}{R}. \qquad (15)$$

The variation of the cutoff frequency $\omega_n$ is directly proportional to the variation of the time constant $\tau$ as can be seen from Eq. (*15*). A continuously variable filter is therefore feasible. $R_a$ and $R_b$ of *Fig.* 3 are ganged potentiometers commercially available. Although tracking is not very accurate, it does not effect the critical parameters as shown below. Assume that the $R_b$ potentiometer is off tracking by $\pm\gamma$ per cent of $R_b$; then, since $R_b = mR_a$ its actual value will be

$$mR_a \pm m\gamma R_a = mR_a\,(1 \pm \gamma)$$

and

$$\frac{e_0}{e_i} = \frac{1}{(TS + 1)\,[\tau(1 \pm \gamma)S + 1]} = \frac{1}{(1 \pm \gamma)T^2S^2 + (2 \pm \gamma)TS + 1} \qquad (16)$$

Eq. (*16*) after feedback becomes

$$\frac{1}{\dfrac{1 \pm \gamma}{1 + K_2K_3}T^2S^2 + \dfrac{2 \pm \gamma}{1 + K_2K_3}TS + 1} \qquad (17)$$

from which

$$\omega_n' = \frac{\sqrt{1 + K_2K_3}}{\tau\sqrt{1 \pm \gamma}} = \frac{\omega_n}{\sqrt{1 \pm \gamma}} \qquad (18)$$

and

$$\zeta' = \frac{\omega_n'(2 \pm \tau)}{2(1 + K_2K_3)} = \frac{(2 \pm \gamma)\tau}{(2\sqrt{1 + K_2K_3})\tau\sqrt{1 \pm \gamma}} = \frac{2 \pm \gamma}{2\sqrt{1 \pm \gamma}} \times \zeta \qquad (19)$$

where $\omega_n$ and $\zeta$ are the values determined from Eqs. (*7*) and (*8*). For a $\gamma = \pm 10$ per cent, the variations of $\omega_n$ and $\zeta$ from the original values are negligible. A 10 per cent tracking accuracy, which is usually obtainable with standard ganged potentiometers, will therefore give very satisfactory results.


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## PLANNING FOR HOME MUSIC

(*from page 25*)

it is usually mounted above the amplifier or, if width permits, alongside the amplifier chassis. In any case, it is mounted close to the amplifier so the controls may be easily coordinated.

*The Tuner Control Chassis:* Usually an AM-FM tuner, with complete audio control facilities including a phono-preamplifier for magnetic cartridges and a record compensator (in the newer models). Some types have push-pull audio amplifiers built into the same chassis for compact installations. The tuner-control unit was designed mainly to feed a basic power amplifier of good quality. There have been one or two FM tuners with control features, but they are no longer made, since this feature proved popular only in the AM-FM models. The tuner-control unit is somewhat wider than the basic tuner and usually deeper. Height is basically the same with one or two exceptions.

*The Compensator:* An accessory of compact dimension for use with some tuner-control units or amplifiers that do not have a record compensator in the circuit. Usually this unit is mounted in proximity to the audio control chassis because of the small output cable supplied (this length is critical and should not be increased). Since most modern audio control units (on both tuners and amplifiers) include a record compensator circuit, the accessory compensator will not be required in an installation except in special situations. It will be used mainly in revamping an existing system.

*The Audio Amplifier:* A complete circuit with complete control facilities which includes: selection of inputs, record compensation, bass and treble controls, volume control with loudness control (in some types only), plus added features, depending upon the manufacturer. These features may include cut-off filters for bass and treble frequencies which will reduce surface noise and rumble, or they may have a single switch position to provide these features. The more economical types, which are of excellent quality (both design and performance) are found on a single chassis. The more costly are made with a separate control unit and a separate basic power amplifier. Some types of two chassis units provide complete remote control as all input jacks (connections) from the tuner, record player, TV tuner, tape recorder, etc., are on the basic power amplifier and the control unit is connected with a single cable from as far as 35 to 100 feet. The other types of two chassis amplifiers are impractical for use in this manner because of the large number of cables required between the control unit and the basic power amplifier, despite the fact that a cathode follower output may be provided in the control unit. The one factor making it impractical is that the lead from the phono cartridge on the record player should not be run in excess of 8 to 10 feet without a cathode follower. The basic power amplifier is used with the tuner-control unit as often (if not more so) as the audio control unit in present day installations. This is because of the simplicity in layout which such a combination offers. It provides the music lover with minimal requirements for space, especially if the cabinet to be used is compact, such as that shown in *Fig.* 4. Here, the basic amplifier was placed within the speaker enclosure (which has ample volume) with adequate ventilation provided by the open reflex port of the cabinet.

*The Record Changer:* This unit mounted on a base, requires a minimum of 16 in. in width. However, if a base is not used, the dimension may be as small as 15 in. (except in the cases of some types of changers). Depth must be 16 in. minimum for comfortable operation. If space is at a premium, the music lover can get one of the diminutive manual record players which only requires a depth. of 13½ in. and a width only a small fraction of an inch larger. The minimum height for a record changer, is 11 in. if mounted on a base, 7½ in. if mounted on a motor board. The small manual record player requires only 6 inches above the motor board, or a total of 10 in. if a base is used.

*The Transcription Player:* This unit requires considerably more space than a record changer. The bare minimum using present day equipment is 18 in. wide and 16½ in. deep. Some combinations of turntables and arms require as much as 28 in. in width by 18 in. in depth while the average installation can be made into an area of 21½ by 21½ in. This problem exists because of the relationship of the turntable motor to the cartridge that is mounted into the arm. Unless a turntable and arm are mounted in the proper relationship excessive hum will result. Depth below the motor board for the average turntable is from 4½ to 5 in.; some professional types using hysteresis motors require from 6 to 7 in. Height above the motor board varies with the height of the pickup arm, from 3 to 4½ in. If greater ease in operation is desired, more clearance is desirable.


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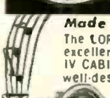

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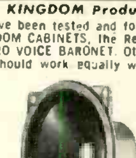

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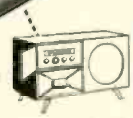

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*The Tape Recorder:* Usually requires a large compartment unless it is a panel-mount chassis of compact dimension (20 in. wide by 13 in. high). Most pan-chassis types are 16 in. deep by 22 in. wide, and thus require an area as large or larger than a transcription type record player. If a portable type tape recorder is to be used, an area greater by 4 in. on all rides should be calculated so the unit may be set into the cabinet when used and removed for portable use if required. Some music lovers may elect to remove the recorder and amplifier chassis from the portable case and mount them within the cabinet structure for permanent use. Most types of portable recorders will not operate in any position other than horizontal, though one or two can be panel mounted if certain modifications are made. *Figure* 5 illustrates a tape recorder in its own case set into the hi-fi cabinet structure so that it can easily be removed.

*The Television Unit:* This unit is easy to include into a system, especially if the cabinet is to be made to order. Because of the large dimension demanded by a TV chassis and tube a minimum cube of 24 inches on all sides is required for a 17-in. or smaller tube. When a 21-in. or larger tube is used, the proportionate increase in size becomes great. Care must be exercised in calculating the proper size for a compartment to ensure adequate ventilation and room for servicing the unit in the cabinet.

### Choice of Components

Whatever the reason for choosing particular components, it is wise to consider facilities in which to house the equipment at the same time. *Figure* 3 shows a basic and functional method of installing a hi-fi system. The loudspeaker is mounted into a corner enclosure located in the adjoining living room. The small triangular speaker cabinet is primarily for monitoring purposes and serves to provide low level background music while the listener is working at his desk. Because the room was small in size, the addition of a cabinet would have created problems. By simply adding two shelves 16 inches deep, it was possible to mount the changer into one shelf with audio control unit and radio tuner in a simple protective case. Above the components, a shallower shelf (deep enough to store records) was mounted in the same manner. Extreme flexibility is realized from such an arrangement as the shelves are removable. The basic power amplifier is installed behind the perforated masonite panel in the small cabinet below the components.

When building a special enclosure for a music system, added features may be included with space for storage of personal articles or display of decorative embellishments. Shown *Figure* 5A is an outline sketch of component arrangement. The unused areas provide considerable storage space. In the photograph of the finished cabinet (*Fig*. 5) a skeleton network of shallow shelves was added to provide ample space for bric-a-brac and trophies. It also fills out unused wall space. Both end compartments (record changer and radio tuner) have a panel door which pulls up and fits back into the compartment above the component. The basic power amplifier is easily accessible for service when required. Simple in design, an enclosure such as this one can be made inexpensively in economical woods or it can be elaborately built of expensive woods with many added sections which can expand to fill the complete wall as shown in *Fig*. 6. This installation uses a basic tuner and a two-chassis audio amplifier. Functional in design, the walls adjacent to the system contain storage areas and compartments. Note that there is a considerable record storage space and the loudspeaker is mounted so that it commands the attention of the entire room. The radio tuner and record player are at a comfortable level below the television unit which is mounted at a proper height for viewing. The audio control unit is installed at about eye level with other accessory units. The louvred shutter type doors can be closed if background or atmosphere music is desired, still permitting ventilation and adequate sound pressure so the benefit of the system's excellent quality can be realized.

Building into a wall, closet or other similar facility affords the greatest flexibility. The closet as a hi-fi enclosure can be used for normal storage of clothes and household necessities if only the loudspeaker is mounted into it. The average speaker-in-a-closet installation is made on a door or into a wall that faces toward the area used for listening. Usually it is mounted just above the shelf in the closet, out of the way of normal usage taking up only a little space. It is not recommended to block the rear of the speaker with pillows and hatboxes, but small articles can still be stored on a shelf that provides but little space to the rear end of a speaker. Mounting the speaker above the shelf (usually 5 to 6 ft. high) places it at an optimum height, providing the best possible coupling to the room. Components can be installed into closets so that only part of the normal use is affected or, as in the case of the installation shown in *Fig*. 7, all of the closet space can be utilized. The lower section provides three shelves of generous record storage space plus room for the basic power amplifier. The center shelf houses the tuner-control chassis and record player, with a utility shelf above for the han-



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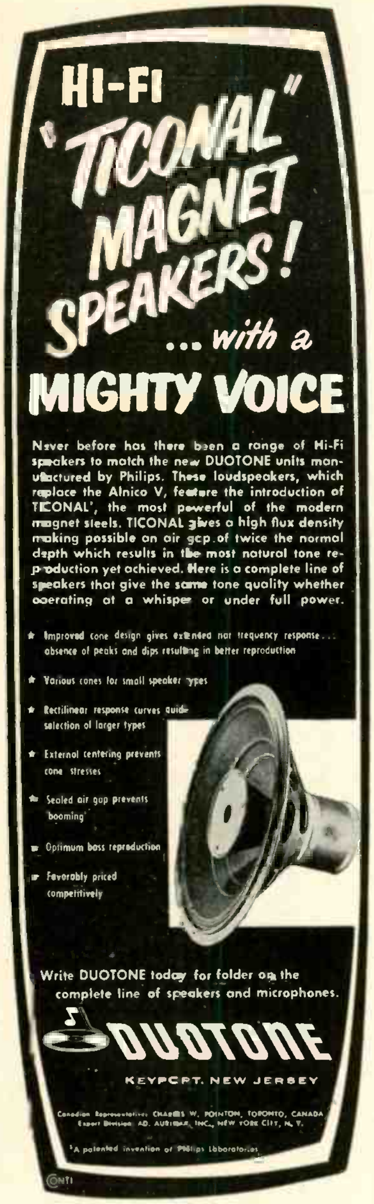


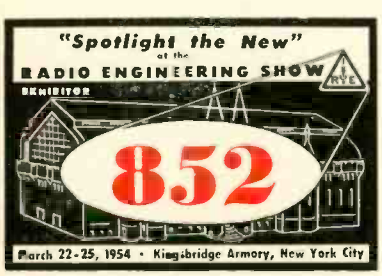


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dling of records in use. The upper portion contains the loudspeaker system. While this installation requires the door of the closet to remain open while the system is in use, a slight modification could be made to permit use of the system with the door closed. For instance, the top panel could be removed and replaced with a grille fabric and for added ventilation the lower panel could be replaced with louvres or a matching grille fabric. This type of installation also permits the addition of a tape recorder which can be installed in one of the record storage shelves below the radio tuner.

It is often said that the most comfortable room in a home is one which has a fireplace and a fireplace is usually surrounded with book shelves. Practical planning facilitated installation shown in *Fig.* 8 which occupies a small amount of wall space and eliminates the need for added furniture, often difficult to blend into a room. In *Fig.* 8A note the manner of planning the layout of components. This music lover, a fastidious collector of LP records required the use of a manual turntable to play his slow-moving musical platters. Since his collection of standard groove records was also very large he could not deny the utility a record-changer could offer, especially for reproducing a complete opera that may appear in two full albums. Using a radio-tuner with built-in audio controls he was able to place both record players and the tuner on a single shelf with the speaker system directly below.

Rebuilding the bookshelf that normally graces the side of a fireplace is extremely popular, and the most practical and least expensive means of housing a music system. This is illustrated in *Fig.* 9 which shows the results of extending the lower section of a normally narrow set of bookshelves. A closeup view in *Fig.* 10 better illustrates the simplicity of layout, where everything is within convenient reach. Here, maximum utility was realized within a minimum of space. The fireplace need not have surrounding bookshelves to offer space for installing the family entertainment center. In *Fig.* 11, an area which normally would not lend itself to conversion was transformed into an effective enclosure providing a tailor made corner for a speaker system. It also permitted mounting the television chassis where it could command the attention of the entire room. The radio tuner (with all audio controls) is mounted at a very convenient working level with the record player. Aside from its almost complete effectiveness, this type of installation can well be the most economical.

Further discussions of the advantage of careful planning will follow in Part 2 of this article next month.




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LOW-FREQUENCY AMPLIFICATION, by N. A. J. Voorhoeve. New York: Elsevier Press, Inc., 1953. xv + 495 pages. $9.00.

This is another work in the Philips Technical Library published by N. V. Philips Gloeilampenfabrieken in Eindhoven, Netherlands. The Library is growing fast and this volume will be of interest to a great many technically minded people in the United States. This is particularly so since for some reason U. S. publishers have still not issued what one might call a definitive or even adequate work on audio engineering, though there has been a small waterfall of books advising the consumer on "hi-fi," God rest the term.

Dr. Voorhoeve has done a good, workmanlike job here, with plenty of useful design and application information, though not on the level where English degenerates into number-language. The book starts off with a brief recapitulation of principles—a.c. technique, distortion, interference, units of measurement, and the like.

Next comes a rather informative chapter on the design and construction of tubes, and the meaning and usefulness of characteristics figures. The tubes used as examples are, of course, those of Philips, unfamiliar in this country, but the information is applicable to our own.

Preamplification and power amplification take up the next two chapters, with explanations and examples of the known circuits, plus design formulas but not any unnecessary derivations which so often serve merely to point out the erudition of the writer. The subject of feedback is treated in the same useful way, and system composition is handled in the discussion of matching, control, and limiting.

Two unusual chapters come next; they deal with the components required for practical audio systems—resistors, capacitors, transformers, rectifiers, and the like. The information here is valuable, the more so for not often being set down in print. A chapter on power supplies covers various types for various purposes.

After a discussion of some acoustic principles, the author goes into transducers—input sources and loudspeakers—and then concludes with five chapters on general aspects and applications.

While Dr. Voorhoeve's book may not be the last word (it does not concern itself with home music systems as such), it is well worth the space it will occupy on any audio man's shelf.

RADIO DATA CHARTS, by R. T. Beatty, revised by J. McG. Sowerby. London: Iliffe & Sons, Ltd., 1953. 91 pages. $2.00

This is a series of 43 of what the British call "abacs," first published in 1930 and since become a standard work used by many thousands of electronics people, principally in Europe.

The book is principally concerned with receiver design and it provides a large variety of easy information to that end. Nomograms predominate, with some charts and simple conversion graphs. The subjects covered are too numerous to mention but include for example, frequency-wavelength, L-C-F, coil design data, selectivity, transformer winding, amplifier gain, decibels, dividing networks, wire tables, and the like.


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# RECORD REVOLUTION

(*from page 29*)

production have languished and died because of the failure of the public to buy. For every great novel, there are thousands of Spillane's. And who buys and reads poetry any longer? But printing, after all, can neither change the feel, the impact, or the sound of an author's words. They are exactly reproduced as written. True, a good printing job results in a more attractive presentation of the author's material—but the end product is the same.

Recordings involve a difference of some consequence. A poor performance and a poor recording can do great and irreparable damage to a composition. And who's to know the difference in the case of a new work. The sole guide, in the long run, is the A & R man. He is the aesthetic conscience of a recording session. If he doesn't know his business and if he's irresponsible, the consequences are sad indeed. Sooner or later his sins catch up with him—but why wait that long! So, dear readers, you have been put on guard. If you are indiscriminate in your record buying, closed-minded, unwilling to take chances with unknown names and unknown composers, the end result is brutally clear. You will pave the way for a mediocre musical future. There isn't too much money to be made out of music any longer. Few, if any, serious composers can make a living out of their work. Only a handful of conductors can get orchestras—and thereby money, glamor and fame. The vast—the extraordinarily vast—number of musicians aren't making a living today. If we get back to books again, the writer has an infinitely larger market for his talents than the composer or the musician. He can depend on advertising agencies, newspapers, magazines, radio, television, motion pictures, in addition to publishers. Not so the composer. If you reject the experimental, the new, you reject the composer of serious music in our time. Too much rejection breeds elimination. A healthy musical future depends on your willingness to give it a chance via records. And if you indicate your willingness by purchasing new music, the record companies will do their part.

I doubt very much whether Columbia expected or expects to make any money from *The Rake's Progress*. I doubt whether they've made any money on a superlative recording of a work which was buried until recently—a magnificent, important work—Alban Berg's *Wozzeck*. Practically your only chance of hearing them is through these two recordings. But after all—Stravinsky and Berg are both important names in the history of music. What about the little names that aren't in the books—the names that nobody knows but which are inextricably tied together with the music of the future? Not the concert hall, not the critics, but the average record buyer in every town in the United States will either put them in the books or destroy them forever!

# ERRATA

On page 30 of the February issue, the diagram for the Tetrode Amplifier showed a power transformer with a voltage rating of 200–0–200 as supplying a d.c. output voltage of 330. Many of our readers believe that the transformer should have a higher voltage, with the concensus being that it should have been listed as 275–0–275. We regret to say that we must agree with them.

Also in the spirit of accuracy, we are forced to admit that the Table on page 62 of the same issue should have been headed as shown below. The columns for HEIGHT and WIDTH were under the wrong headings—as should have been obvious—but no one but the author seemed to notice this one. Furthermore, says Mr. Greene, the lines under TAPE RECORDERS should have had some asterisks—and should have read

**mounted vertically***
**mounted horizontally****

These changes can be made by the reader with little trouble.

For both errors, our apologies.

**TABLE 1**

**MINIMUM CABINET SPACE REQUIREMENTS**

**(in inches)**

**for average high-fidelity components**

| Component | Width | Depth | Height |
|---|---|---|---|
| FM tuners | 15 | 12 | 11 |
| AM-FM tuners | 16 | 12 | 12 |
| Amplifiers—one chassis | 17¼ | 12 | 10 |
| Amplifiers—two chassis | 17½ | 16 | 15 |
| Record changers | 16½ | 16 | 14 |
| Manual record players | 21¼ | 16½ | 14 |
| Tape recorders | | | |
| mounted vertically* | 21 | 16 | 16 |
| mounted horizontally** | 22½ | 16 | 14 |
| TV chassis—up to 17-in. | 24 | 24 | 24 |
| TV chassis—up to 27-in. | 32 | 24 | 27 |
| 10-in. record storage | *** | 12½ | 11 |
| 12-in. record storage | *** | 14½ | 13 |
| 7-in. tape storage | *** | 8 | 8 |
| 10½-in. tape storage | *** | 11½ | 11½ |

* Calculated for Magnecordette and smaller units

** Calculated for Concertone 1500 series and smaller units

*** Width depends upon existing or contemplated record or tape collection. Average LP album is roughly 0.7 in. wide. Single LP record will fit about 7 to the inch; 78 r.p.m. albums measure from one-half to two inches. The width of tape boxes is roughly ⅝ in. for the 7-in. reel and ⅞ in. for the 10½-in. reel.

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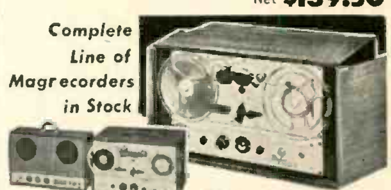

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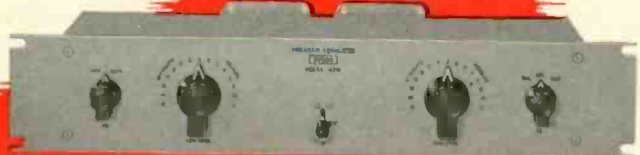

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## EQUIPMENT REPORT

*(continued from page 32)*

cal auxiliary inputs, as shown by Table I. A hum balance control across the heater winding permits adjustment for minimum hum, and a positive d.c. bias on the heaters results in a hum level measured at 62 and 74 db below 1 watt output on phono and radio respectively, with the inputs shorted.

**TABLE I**

**Input voltage for 1-watt output**

| Input | Volts |
|---|---|
| Phono-LP | .0048 |
| " -NAB | .004 |
| " -AES | .004 |
| " -FOR | .004 |
| Radio, Aux I, Aux II | .03 |

## LONDON LETTER

*(continued from page 6)*

the Radio Industry, and, apart from one or two specialties, nothing is sold to the public under the Plessey name.

There are four British firms making changers: B.S.R., Collaro, Garrard, and Plessey. The only other record changer on sale in the British market is the Philips, made by the colossal Philips Organisation in Holland, and now probably assembled in this country.

For playing records without an automatic changer the English high-fidelity enthusiast has even less choice. Probably the bulk of the motors of the non-changing type are made by Garrard and Collaro. A high quality one is made in very limited quantities by Sugden, and there are one or two firms producing very small amounts. E.M.I., of course, also make gramophone motors which are incorporated only in their own machines sold under His Master's Voice and Marconiphone trade marks.

Nearly all firms making gramophone motors and record changers also make pickups, but in addition there are some very fine quality pickups by some specialist companies who only produce a few, but they are of really superb quality. Names that come to mind are Leak and Cosmocord. Leak produce probably the best pickup in England, but owing to the very small output they are most difficult to obtain. These pickups are of the moving coil type, and they refuse to sell them with interchangeable heads, with the result that the user who wishes to have a Leak pickup for playing 78 and LP records has to have two carrying arms mounted at the side of the turntable. Leak resolutely refuse to supply this type of pickup for use on an automatic record changer. There are rumours, however, that a new Leak pickup, which will be produced in larger quantities, will be available soon.

Another manufacturer is Goldring, but



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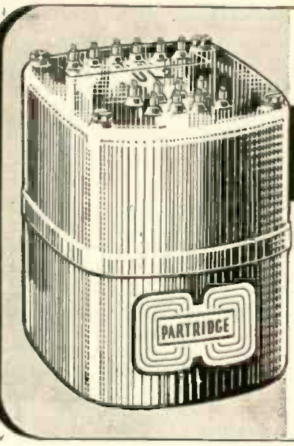
probably the largest sales for pickups sold separately are achieved by Cosmocord. A newcomer to the market is Ferranti, of which good initial reports are heard.

**Amplifiers and Loudspeakers**

In considering amplifiers for the high-fidelity enthusiast, undoubtedly the two makers who have the bulk of the market are Leak and Acoustical Manufacturings' QUAD Amplifier. Leak probably has the largest sales, and is considered by many authorities to be the amplifier by which all others are judged. Popular priced amplifiers are made by Trix and Grampian. There are numerous other small makers, but the only four amplifiers distributed on a National scale are Leak, Quad, Trix, and Grampian. Manufacturers of loudspeakers are legion, and it is impossible to mention all the makes. The set makers' loudspeakers are usually supplied by Rola-Celestion, Goodmans, Plessey, R. & A. Amplifiers, and Stentorian. The high-fidelity enthusiast can choose really from a dozen makes, including Wharfedale, Stentorian, Tannoy, the better Goodmans' models, some of the Truvox ones, and then there are specialised loudspeakers such as the Acoustical Ribbon one, the Lowther-Voight, and other ones costing over 300 dollars each. I have not mentioned speakers which are made by set makers themselves. Probably the largest set manufacturer making loudspeakers is Plessey, who also supply quite a number of loudspeakers to other complete set manufacturers.

The greatest problem with which the high-fidelity enthusiast in England has to contend is probably the same as in America—where to put his loudspeaker. If one believes, as most English people do believe, the statements by Briggs (probably one of the greatest authorities on loudspeakers in the world) it is absolutely essential to have a large enclosure for a loudspeaker. One can get over the difficulty if one has very limited space by a compromise, such as using an enclosure similar to your American RJ, but if one wishes to do the job really properly then, according to Mr. Briggs, it is essential for a 15-in. loudspeaker to have an enclosure of at least 9 cubic feet. If one also follows Mr. Briggs in having two loudspeakers to deal with the treble, it means that even with his economical cabinet work the loudspeaker costs about £75 ($210), which is just over twice the price of the Leak amplifier, which somehow seems to be ridiculous.

As labour costs in Britain are probably one-third of those ruling in the U.S.A. it is obvious that apparatus which require a high labour content can be produced more economically in this country or, alternatively, manufacturers are able to spend more on labour to produce an instrument of the equivalent price. It is probably for this reason that some British manufacturers, whose products entail a large amount of labour, are able to produce very high quality instruments of considerable reliability. Although the sales of these products in the United States must be very small compared with your mass produced lines, they nevertheless presumably fulfil a demand from those enthusiasts who want the best regardless of price. On the other hand,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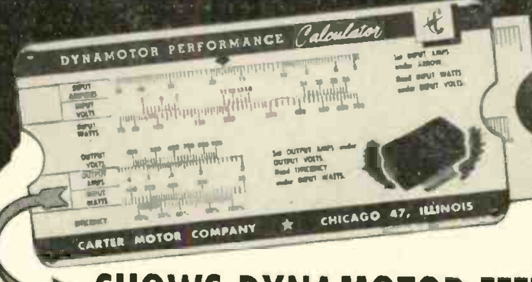


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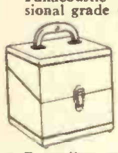

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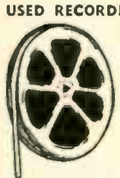

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Fisher — Bozak
And All Others

**ON DISPLAY**
**IMMEDIATE DELIVERY**

**Visit Our Studio • Mail inquiries invited**

**BELL TONE** SOUND CORPORATION
11 N. PEARL ST., ALBANY, N. Y.
Telephone 5-4665


with the tremendous market you have, probably three or four or even more times greater than in this country, when it comes to a highly mass produced line, then all of Europe has to bow to the ability of the American factories.

**Records**

I have received some enquiries about "Angel" records. These are, of course, pressed in England at the E.M.I. plant at Hayes. They represent the records which would have been issued in America under the Columbia trade mark but for the fact that the English Columbia Company, controlled by E.M.I., has now no working arrangement with the American Columbia Company. As most of my readers will know, the E.M.I. Company in England controls H.M.V., Columbia, Parlophone, Regal-Zonophone, and M.G.M. records. The English and Continental H.M.V. recordings which are likely to be of interest to U.S.A. listeners are usually issued under the R.C.A.-Victor trade mark. Up to a few months ago the English Columbia records were issued under the American Columbia trade mark. When the arrangement with Columbia lapsed, E.M.I. were faced with the problem of establishing a trade mark in the U.S.A. under which they could issue the British Columbia records. They decided to revert to their first trade mark of all, namely that of the "Recording Angel" which was used by the original Gramophone and Typewriter Company Limited early in the century when the Company had the copyright in the word "gramophone." When they lost the use of this trade mark they commenced to use the His Master's Voice one, and whilst for a time both the H.M.V. and Angel trade marks were used, eventually the Angel one was dropped.

As the photograph illustrated here will show, a lapse of 44 years does not matter in British factories for the same man who pressed some of the original Angel records is now pressing those which are made at Hayes exclusively for the U.S.A. market.

# CLASSIFIED

Rates: 10¢ per word per insertion for noncommercial advertisements; 25¢ per word for commercial advertisements. Rates are net, and no discounts will be allowed. Copy must be accompanied by remittance in full, and must reach the New York office by the first of the month preceding the date of issue.

AUDIOPHILES wanted for part or full time work. Technical or secretarial experience desirable. Location: north suburban Philadelphia. Send resume of education and experience to Box CM-1. AUDIO.

HEAD ALIGNMENT and record level adjustment tape. $4.00 postpaid. E. J. Lesher, 2730 Heatherway, Ann Arbor, Mich.

PRESENCE—enjoy the realism of a Williamson-type amplifier at reasonable cost. Write the Long Island Sound Co., 19 Bennett Place, Amityville, N. Y.

SELL: Collins FM-11 FM tuner. Used three months. $45. FOB. B. A. Shaver, Box 265, 333 Cedar, New Haven, Conn.

WILLIAMSON amplifier, parallel PP KT-66, Partridge CFB, custom components, heavy duty power supply, with Altec A433A front end, $145. Apt. 3M, 34–35 76th St., Jackson Heights 72, N. Y. ILlinois 7-8649.

STEPHENS 106AX speaker in Stephens mahogany enclosure with throated port, $110. Browning RV-10 FM tuner, $55. Excellent condition. Baumel, 787 East 175th St., Bronx 60, N. Y. CYpress 4-3540.

FOR SALE—COLLINS 32V3, $590; 75A3, $430; both nearly new. Sacrifice both, $995. Altec 604B in 606 mahogany enclosure, $200. Robinson 16-in. Transcription Turntable, 33 and 78 r.p.m., $50. Write Box CM-2, AUDIO.

SELL: ALTEC 604B with network, like new. $110. George Heap, 3435 South Utah, Arlington, Virginia.

TANNOY SPEAKERS, coaxial, available NEW YORK area. Call (New York) PLaza 7-8569 (evenings REgent 7-2642) for opportunity to hear one in high-fidelity custom music installation. You will be impressed. BOHN MUSIC SYSTEMS.

SEND for free data on battleship-built Williamson amplifiers and 30–20,000 cps systems. Nicely Associates, Kenton, Ohio.

TRADE AUDIO IN MID-MANHATTAN
Announcing the opening of our new Mid-Manhattan Audio and Record Showrooms—where you can buy all nationally advertised new audio components for low cash prices or with gigantic trade-ins on your used equipment—where you may choose from a large selection of *reasonably* priced but warranted used equipment—where LP record prices for Hi-Fi discs are unbelievably low—where all your audio problems and repairs can be handled.
Opening Specials: 30-watt Ultra-Linear Williamson, ($129 value), with KT-66's, Partridge, $77; 50-watt Laboratory Amplifier, ($159.95 value), with 1614's, 5AW4's $99.95. Famous tape recorder, 7½- and 15-in. speeds, takes 10½-in. NAB reels, ($350 value), $290. All above equipment brand new, full warranties; mail orders also cheerfully filled. Famous make 3-way speaker systems in Mahogany corner horn (a $275-net value), you pay only $180. Specials to Record Collectors: Famous Westminster Hi-Fi LP's, ½ price—$2.98 per 12-in. record, $2.00 per 10-in. record. Free postage. All other LP's except price-fixed labels, 40% off List. Add 75¢ per shipment for postage.
INTERNATIONAL AUDIO and RECORD EXCHANGE
1101 Lexington Ave., New York 21, N. Y. One flight up—Hours: 12 to 9 p.m., 6 days. Phones: REgent 7-8334 MOunt Vernon 7-4184

WANTED—Magnecorder tape recorder or Magnecordette semi-professional. Microphone to 15,000 cps. State accessories, price and condition. Clarence W. Smith, 812 S.W. Washington, Portland 5, Ore.

HALLICRAFTER S-47-C, AM-FM-SW receiver. Will sell to best offer. Dr Nicely, Kenton, Ohio.

TELCOA (Audio Equipment Exchange) We sell all types of new guaranteed audio equipment. Highest trade-in values throughout the world. Increasingly liberal trade-in allowances with cumulative purchases.
Azurelee Dome, Malibu, California.
GLobe 6-2611

ALTEC Lansing speaker for sale. Perfect 604B with network, slightly used, in original carton, $100. L. D. Harmon, Box 382, Kingston, N. J.

PRESTO 6N in 1D case. $375; 85A, $75; 90B with 161 Eq. $400. RCA KB2C mic. on KS5A stand, $40; 76B2 console, $450. W.E. 639 mic. $75. Ampex 403C, $650. Meissner, 4630 Woodside Tr., Portland, Ore.

FOR SALE: Scott 112B noise suppressor-preamplifier, factory reconditioned, $35. Thomas Hudson, 275 W. 150th St., Ney York 39, N. Y.

FOR SALE: (Phila. area) Fisher 70-RT, 60-watt Ultra-Linear Williamson, 12-in coaxial bass reflex, used 8 hours, $275. Box CM-3, AUDIO.

KLIPSCH H.F. HORNS (3)—were used 10 mos. in stereo experiments. 1.00 and 0.875 throats. 30% under cost ea. G. Cain, 30 Waverley Terrace, Belmont, Mass. BE 5-4911R.

CRAFTSMEN C-10 tuner in excellent condition. $75; RC-2 amplifier. $25. Norman Tetenman 2350 East 27th St., Brooklyn, N. Y.

COAXIAL speakers, tweeters, crossover networks, amplifiers, gain set, speaker enclosures, other items new and used. All below current market price. Write Box CM-4, AUDIO, P.O. Box 629, Mineola, N. Y.




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## PROFESSIONAL DIRECTORY

**FULL DIMENSIONAL SOUND**

FDS FULL DIMENSIONAL SOUND

THE ULTIMATE IN
**HIGH FIDELITY**
RECORDING

Capitol

Look for this symbol on record albums you buy!

**"WE HAVE IT"**
HI-FI COMPONENTS EXCLUSIVELY
**HOLLYWOOD ELECTRONICS**
7460 MELROSE AVE.
HOLLYWOOD 46
CALIFORNIA
WEBSTER 3-8208

**HIGH-FIDELITY HOUSE**

Offering the World's Finest Home Music Systems, created by experts with years of experience.
High Fidelity is our only business—not a sideline. *Complete stock* of every worthwhile component *at all times.*
536 South Fair Oaks, Pasadena 1, Cal.
SY 5-4118 RY 1-8171

**"EVERYTHING IN HIGH FIDELITY"**
From Primary Components
to Completed Custom Audio Equipment
**KIERULFF** *Sound Corp.*
820 West Olympic Blvd. • Los Angeles 15, Calif.
Richmond 7-0271 ZEnith 0271

Custom-Built Equipment
**U. S. Recording Co.**
1121 Vermont Ave., Washington 5, D. C.
Lincoln 3-2705

**HI-FI AUDIO RESISTORS**

Low-noise, deposited-film type, 1% guaranteed tolerance, WE licensed, beautiful appearance, brand new. Enough resistors for Williamson or several pre-amps. Kit: 2-50K 2W, 2-20K 1W, 2-470K ½W, 1-47K 1W, 2-100K 1W. A $6.50 net value for only *$4.39 P.P.* Air Mail add 15¢. Money back if not completely satisfied.

SOUTHERN ENGINEERING
Dayton Pike Rt. 5 Chattanooga 5, Tenn.


# *Industry People...*

**Lewis Newman,** president of The Daven Company, announced last week the appointment of **J. P. Smith,** formerly Daven's chief engineer, as Director of Engineering—**Walter Voelker,** formerly of Day & Zimmerman, Inc., and Bell Telephones Laboratories, replaces **Smith** as chief engineer . . . **Lawrence R. Thielen,** formerly with RCA Service Company, is new sales engineer in the New York office of the Ampex Corporation—appointment announced by **Harrison Johnston,** Ampex general sales manager . . . **Oscar Kraut,** formerly assistant manager of Arrow Audio Center, New York, is new additionto sales staff of G & H Wood Products—will handle sales of Cabinart line in New England area.

The industry gets a touch of glamor in the appointment of **Miss Lorraine Webb** as the first distaff sales engineer — she will represent Arrow Electronics, Inc., New York, in the New Jersey area . . . **Walter S. Holmes, Jr.,** acting controller, has been elected controller of Radio Corporation of America . . . **Robert G. Bach,** formerly in charge of TV sales for Federal Telecommunication Laboratories, is new assistant sales and advertising manager of Fairchild Recording Equipment Company . . . **Vito Racanelli** has been named advertising manager of Chicago Standard Transformer Corporation—came to Stancor from Edward C. Kennedy Company, Chicago ad agency.

New distributor sales manager for V-M Corporation is **Merle (Bud) Cain**—formerly assistant TV sales manager for Hallicrafters . . . **John G. Leitch,** vice-president in charge of engineering for Philadelphia station WCAU, awarded a silver platter in recognition of 25 years of service — presentation made by **Donald W. Thornburgh,** station president, at the famous Racquet Club . . . **William A. Ready,** formerly president of The National Company, has been elected to the Board of Directors of Browning Laboratories, Inc., . . . **Walter Jablon,** industry pioneer, has been named sales manager of the Home Instruments Division of the Freed Electronics & Controls Corp., New York—will concentrate on Freed-Eisemann line of high-fidelity equipment which will be introduced publicly at an early date.

**Raul H. Frye,** formerly manager of the Special Products Division of Raytheon Television and Radio Corp., has been appointed vice-president in charge of engineering for The National Company, Malden, Mass. . . . **James H. Lynch** has been upped to vice-president in charge of sales by The Kelton Company, Boston, Mass.—other Kelton appointments include **James P. Bray, Robert E. Evensen** and **William S. Nebe,** sales managers in the West, Mid-West, and New England, respectively . . . **John Jipp,** formerly with Motorola, Inc., has joined Ampex Corporation as manager for instrumentation recorder sales.

Twenty-five years of service by three company employees was commemorated recently by **A. D. Davis,** president of Chicago's Allied Radio Corporation, with the presentation of gold watches to **Pete Picciolini, Bill Rudnick,** and **Fred Schnurstein**—award was made before the annual dinner-meeting of the Allied 20-year Club. About 25 per cent of Allied's 400 full-time employees have been with the company five years or more—a record matched by few other firms of similar size and age.


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Information on trading HI-FI components on request. Write or call for free catalog AE

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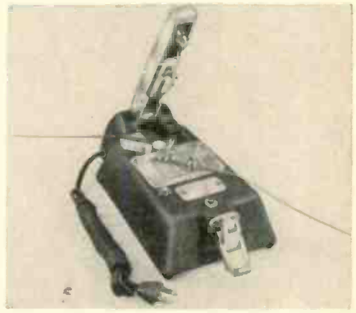
**the audio exchange inc.**
159-19 Hillside Avenue • Jamaica 32, N. Y.
Olympia 8-0445

Now Ready for Immediate Delivery

*The New*
**MT-1 PRESTO-SPLICER**
**for WELDING TOGETHER ¼" acetate tapes without cement or adhesives . . .**

- Diagonal cut capable of withstanding 3 pound pull
- Inaudible with playback amplifier gain at maximum



**$65** F.O.B. Factory
*For Milar Tape, add $2*
**Sample splice and brochure on request.**

**PRESTOSEAL** MFG. CORP.
3727 33rd st., Long Island City 1, N.Y.

Enjoy building it in just a few hours . . then enjoy a lifetime of superb sound reproduction!

**Philmore hi-fi**

**20 WATT AMPLIFIER KIT**
**including Preamplifier**

DeLuxe Model, 20 to 30,000 cycles flat response ± .5 Db., (using Altec-Lansing Peerless S526F High Fidelity Output Transformer). Up-to-date circuiting, featuring the latest and best in High Fidelity amplifier design, with emphasis on simplicity, economy, and ease of construction.

Compact chassis, 12x8x3", complete with all tubes, parts, and famous Philmore "Step-by-step" Instructions. Net $51.95

Available at your local jobber — or write for FREE LITERATURE, to Philmore Mfg. Co., Inc., 113 University Place, N. Y. 3.

PHILMORE MFG. CO., INC., 113 University Place, New York 3, N. Y., Dept. A3. Please send Amplifier Kit literature at once to:
NAME ........................................
ADDRESS ........................................
CITY ........................ STATE ..........

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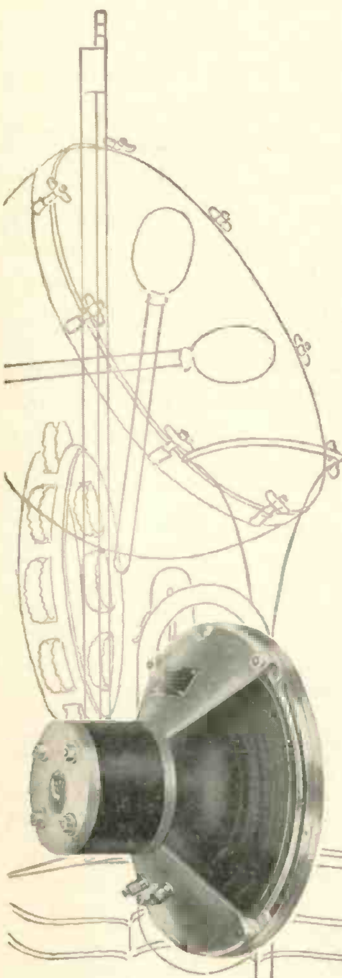
# At Last!

## THE SPEAKER THAT PRODUCES

# No Sound



Fiddles, trumpets, drums . . . these are musical instruments. They produce sound. And resonances are deliberately created to give the sound timbre and identity.

The loudspeaker, however, is not a musical instrument. Its specific function is to **reproduce** sound. It must in no way add to the sound it reproduces. It must be free from resonance, and free from distortion.

**The HARTLEY 215 has no resonance... and produces no distortion.**

Laboratory measurements have confirmed this fact, time and time again. AB comparison listening tests have likewise revealed the superior performance of the HARTLEY 215.

**Treat yourself to an earful.**

Substitute a HARTLEY 215 in any system. Instantly you will hear the difference . . . clean bass, smooth highs . . . and a sense of realism and presence that will amaze you.

**Duty paid *Only* $65**

**NOTE: Because the new Hartley 215 has no resonance, a non-resonant baffle should be used. The bass-reflex, and other conventional enclosures are tuned resonant systems. For best results the Hartley BOFFLE Enclosure is recommended...available in single, dual, and 4-speaker models. Priced from $50.75.**

**THE NEW HARTLEY 215**

*At franchised dealers or write to:*

**H. A. HARTLEY CO., INC.**

**521 EAST 162nd ST., BRONX 51, N. Y.**

**LUdlow 5-4239**

## ADVERTISING INDEX



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*The Tape That Mirrors the Original Sound*

SOUND RECORDING

# irish

BRAND

# GREEN BAND Professional

## THE FINEST TAPE YOUR RECORDER CAN USE

Just as the reflection of a perfect mirror is faithful to the original image, in every detail, so too does IRISH Green Band RECORD, RETAIN and REPRODUCE the original sound with flawless fidelity.

This can be confirmed by tests. Instruments will reveal that IRISH Green Band offers lower noise level, uniform sensitivity, minimum amplitude variation, less distortion.

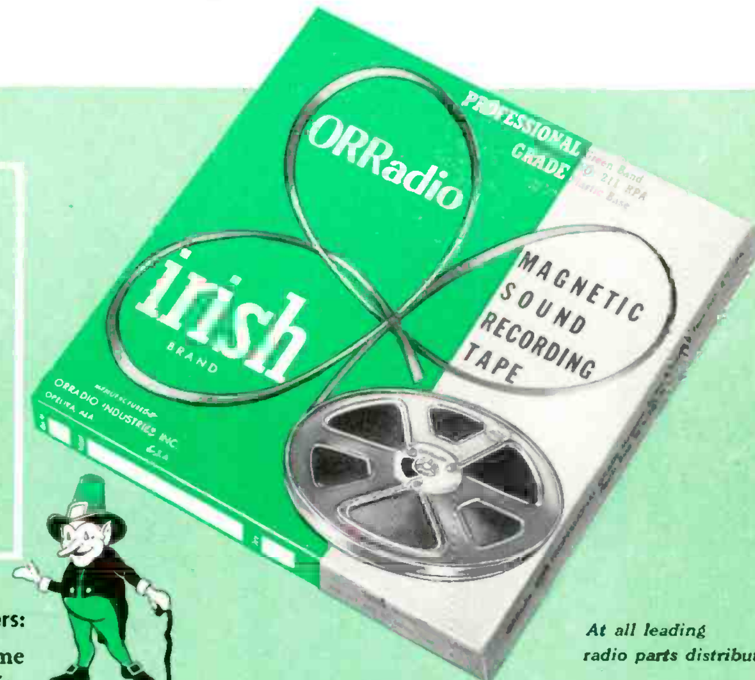
But instrument tests are only the landmarks of good design and production. The final proof is in the hearing. Therefore, to know and appreciate the quality of IRISH Green Band Tape, it must be used, listened to, and compared with other tapes on the same recorder.

You will find that the only limitation to IRISH Green Band quality is the limitation of the tape recorder itself: it is the finest tape your recorder can use.

**irish** BRAND **GREEN BAND Professional** is fast becoming the choice of audio engineers in broadcast stations, recording studios and wherever sound quality is of paramount importance.

1200 feet on plastic reel ........ $3.30 users net
2400 feet on metal reel ........ 7.71 users net

*One day you will surely use IRISH . . . so write today for free test sample reel.*




**irish BROWN BAND for Popular Priced Recorders:**
IRISH Brown Band, expressly designed for home and office recorders. Reproduces with true fidelity the frequency range from 100 to 8000 cycles. A high quality, plastic base tape for the price of ordinary paper tape!
1200 feet, plastic base, on plastic reel ... $2.50 users net

*At all leading radio parts distributors*

**ORRADIO INDUSTRIES, INC.**
OPELIKA 8, ALABAMA
World's Largest Exclusive Magnetic Tape Manufacturer
EXPORT DIVISION: Morhan Exporting Corp., New York, N. Y.

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# Pioneering NEVER STOPS AT UTC

## A FEW 1954 PREVIEWS

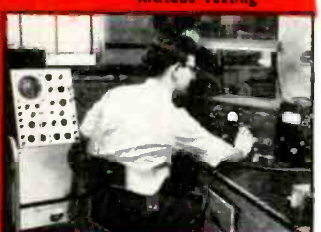
From the time UTC engineers thought up the first humbucking transformer or the ouncer type transformer . . . concepts now standard in the industry . . . UTC has always led in transformer engineering and production. This doesn't come easy. Our development laboratories and engineering staff are largest in the industry. Planned programs of research and development are constantly improving existing products, and perfecting new design concepts.

Illustrated below are a few typical new developments . . . soon to be released by UTC.


Filter Development Laboratory


Development Tests
½ cycle Filter


Humidity — Temperature
Altitude Testing


Pulse Transformer Development


Audio Development Laboratory

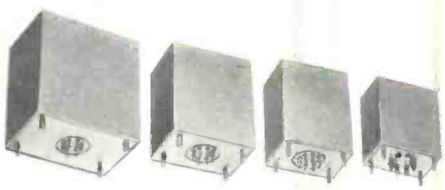
A FEW VIEWS OF THE UTC LABORATORIES

### HERMETIC VARIABLE INDUCTORS

The UTC VIC variable inductors have long filled a need in the electronic industry. Culminating an extensive development program, a new series will provide . . . greater reliability thru hermetic sealing . . . higher Q factor . . . and smaller size.

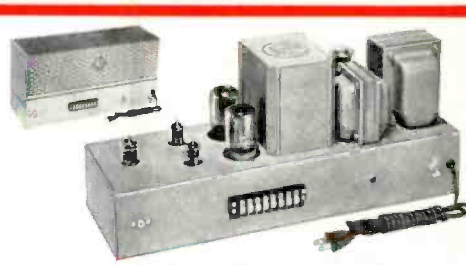

### TRANSISTOR TRANSFORMERS

Reducing the size of conventional transformers to that comparable with transistors results in very low power handling ability and high distortion. A revolutionary approach to this problem has resulted in designs which, in the same volume, provide many times the power rating . . . plus a physical structure of exceptional reliability.



### HIGH-STABILITY MAG-AMPS

High gain magnetic amplifiers used in servo motor applications usually show some instability in use, tending to effect low frequency oscillation. A thorough study of this condition has made possible the development of a new series of mag-amps for motors from 4 watts to 20 watts, with a much higher order of stability.



### ADVANCED DESIGN HIGH FIDELITY AMPLIFIER KIT

While UTC does not manufacture audio amplifiers, an audio application group provides customer service in this field. Their investigation into high fidelity circuits has indicated unrealized weaknesses in most current amplifier designs. To correct these weaknesses, a new circuit will shortly be made available in an amplifier kit of advanced design, both electrically and in the mechanical stability provided by latest printed circuit thinking.

*United Transformer Co.*

150 VARICK STREET • NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

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