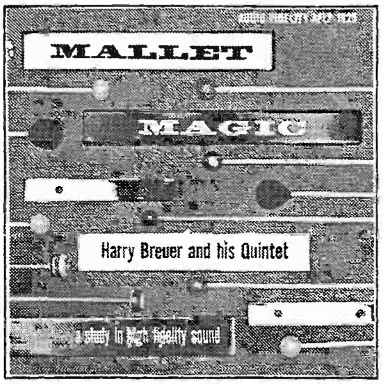

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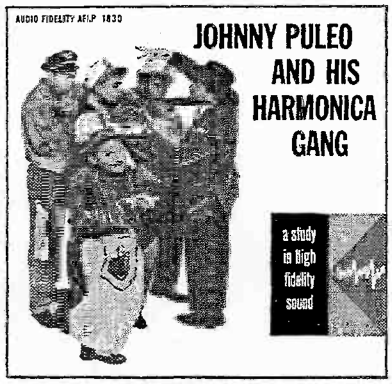

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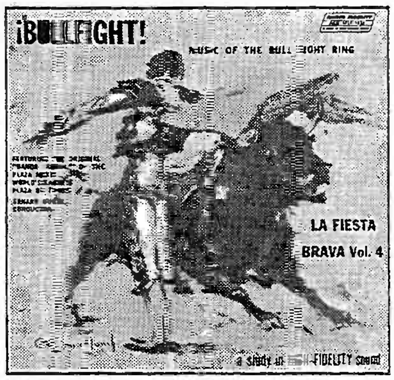

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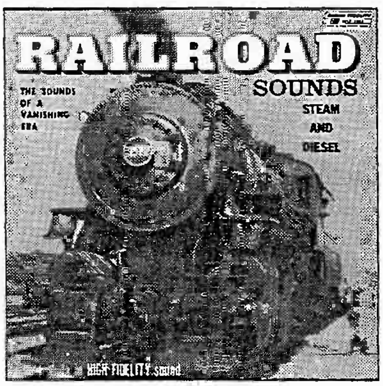

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THE MAGAZINE FOR THE HI-FI HOBBYIST

OCTOBER 1957

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ADVERTISING

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The Grounded Ear

by Joseph Marshall

THERE has been considerable experimentation during the past year and a half with styli of ½-mil radius. The reason for such experiments is that, at very high frequencies (above 10 Kc, especially), the normal 1-mil needle is forced upward by pinch effect, since the groove becomes narrower at very high instantaneous cutting velocities. A ½-mil needle, on the other hand, can follow the wave form more faithfully to provide both a higher output at the high end of the spectrum and lower distortion. Pickering has been offering ½-mil styli for Fluxvalve cartridges; Emory Cook, whose V-groove recordings are particularly well suited to the smaller needle, has been a strong advocate of them.

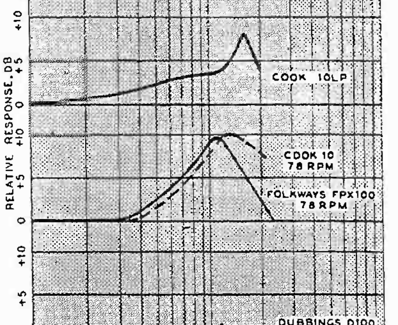
The smaller stylus does entail some new problems, however. Among them is the possibility of greater record wear because of the smaller area of contact between stylus and record. Another is that, on shallow-groove records, the needle may have a tendency to trace with the tip only, rather than with the sides; and its looseness in the wider groove can produce unbearable distortion and, possibly, some damage when the needle is driven hard. This disadvantage can be overcome by the use of an elliptical needle shape: 1 mil wide to fit any type of groove snugly, but only ½-mil or less deep, to conform to the narrow cuts at very high frequencies. An elliptical stylus (2.5 by 1 mil) was used by Ferranti in its 78-rpm cartridge and resulted in a response to beyond 20 Kc. About a year ago Fairchild announced that it would supply elliptical styli (optionally and at higher cost) on its 225-series cartridges. But Fairchild found that the problem of obtaining good elliptical needles at a reasonable price was far greater than was anticipated. Only a few diamond cutters could produce acceptable styli, and the cost was prohibitive. Therefore, the commercial offering was abandoned, although it is still hoped eventually that a source of these needles good enough to justify offering them will be found.

About a month ago, Fairchild sent me a handmade version of the 225/XP with an elliptical stylus. To say that I am delighted with it would be an understatement.

Its performance follows theoretical expectations. First, the high-frequency response is considerably increased in amplitude. In effect, the elliptical needle produces a rising response beginning at about 5 Kc. This is quite plain to a sharp ear in listening and obvious on measurement. The shape of the curve above 5 Kc will depend on the material from which the recording is made. On the Elektra 35 test record, which is made of a stiff material, the rising response is smooth and the peak rise is 3½ db, with a +1-db response at 20 Kc (see graph). On the Cook 10LP the rise is similar, but there is a fairly sharp peak at 17 Kc. This peak can pretty safely be ascribed to groove-needle resonance since there is no sign of it at all on the Elektra. This is further verified by the response on the Folkways FPX 100, recorded and played back at 78 rpm; this shows no discontinuity at 17 Kc, such as would be evident if the peak were due to pickup resonance. Here we have a big, but wide, peak at about 12 Kc. The Cook 10 at 78 rpm produces a similar curve. Altogether these curves indicate a response which, in the absence of groove-needle resonance, would rise to 3 or 4 db at around 15 Kc, and slope to zero db at about 22 Kc. The groove-needle resonance on the Cook 10LP is not bad either, being only 4 db above the main curve on either side.

At first glance these curves may not seem to represent any improvement at all. The normal 225A with a round 1-mil needle is within 1 db to 17 Kc, and other wide-range pickups have similar flatness. If the boost were the only thing the narrower stylus provided, its virtues would be questionable. Some systems with highly efficient tweeters already have too much response in this region, and the additional boost would call for changing the balance. The real improvement is not evident on frequency-response curves, but is plainly audible to the ear and visible on scope traces. First, the high-frequency wave form is more faithful to the original. Second, the transient response is quite superior. This is evident with square-wave traces but equally obvious to the ear. The result in listening value is better definition of extreme highs, especially when they are heard within a complex mass of sound. Thus, in my copy of Mussorgsky's *Pictures at an Exhibition*, the rolling tambourines in one of the crescendos are clearly identifiable; with many of the best previous pickups they were not too distinctly defined and many people mistook them for overload distortion. Also, the improved transient response makes the percussive highs with sharp envelopes sharper and cleaner. This is particularly noticeable on the high notes of piano and xylophone, plucked strings, brushed snare drums, etc. The effect of all this is very much like the effect on visibility produced by washing a window, or on the colors of a great master when a picture has been skillfully cleaned of surface grime. It is not so much that the ear hears any more as that what it hears is more sharply defined and identifiable. The best records are

Response curves of the elliptical stylus with respect to several test records. Only the high frequencies are graphed, since that is where response is most improved.



scarcely distinguishable from original master tapes, and good pressings sound like fresh lacquer masters played with 1-mil needles. In short, another layer of coloration and obscuration is removed from the reproducing system.

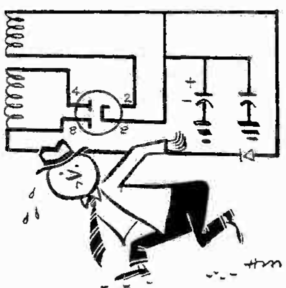
I have repeatedly observed that there is a price to pay for everything, and this improvement does not escape the truism. I have pointed out that tweeters may require rebalancing unless the treble boost of the smaller needle simply makes up for a loss in some other part of the system. Some tweeters may turn out to be either too efficient or just not good enough to stand the boost. Then too, if the best records sound better, the worst will sound much worse. Distortion which was previously obscured by system fuzziness will now be resolved into annoyance. Also, the elliptical needle seems easier to overdrive than the larger round 1-mil needle and some records which sound fine on a regular 225 cartridge will show distortion in some peaks. Many of the pop recordings which are cut, apparently, 6 to 10 db higher than classics, and are troublesome even to the very best round-needle pickups, may be intolerable with the elliptical. Audiophile recordings, on the other hand, can have every quality of stereo reproduction except the right-and-left directionality. Finally, the smaller needle produces groove-needle resonance at a lower frequency. The 225 with the 1-mil stylus does not resonate with the Cook test record within the 20-Kc top of the recording, but, as the curve in the graph shows, this one resonates at 17 Kc. This will not be as much of a point in the future as it may be now. Cook's Microfusion disc is much stiffer; so, apparently, is Audiophile's new disc. It is highly probable that this is merely the beginning of a trend to stiffer plastics.

To summarize, the elliptical needle on a cartridge of first quality such as the Fairchild provides a still closer approach to the ideal of perfect reproduction. But remember that the elliptical needle is still experimental, and not available commercially.

Dynakit Front End

I have had a number of letters from people who want to convert the older

Continued on page 40

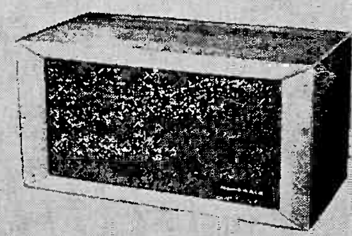


HEATHKIT "BASIC RANGE" HIGH FIDELITY SPEAKER SYSTEM KIT

The very popular model SS-1 Speaker System provides amazing high fidelity performance for its size because it uses high-quality speakers, in an enclosure especially designed to receive them.

It features an 8" mid-range-woofer to cover from 50 to 1600 CPS, and a compression-type tweeter with flared horn to cover from 1600 to 12,000 CPS. Both speakers are by Jensen. The enclosure itself is a ducted-port bass-reflex unit, measuring 11½" H x 23" W x 11¾" D and is constructed of veneer-surfaced plywood, ½" thick. All parts are precut and predrilled for quick assembly.

Total frequency range is 50 to 12,000 CPS, within ±5 db. Impedance is 16 ohms. Operates with the "Range Extending" (SS-1B) speaker system kit later, if greater frequency range is desired. Shpg. Wt. 30 lbs. MODEL SS-1 $39.95

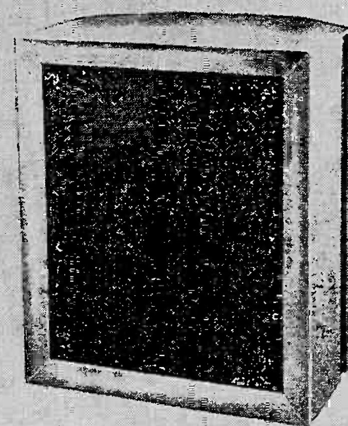


"BASIC" SPEAKER SYSTEM

HEATHKIT "RANGE EXTENDING" HIGH FIDELITY SPEAKER SYSTEM KIT

The SS-1B uses a 15" woofer and a small super-tweeter to supply very high and very low frequencies and fill out the response of the "Basic" (SS-1) speaker system at each end of the audio spectrum. The SS-1 and SS-1B, combined, provide an overall response of ±5 db from 35 to 16,000 CPS Kit includes circuit for crossover at 600, 1600 and 4000 CPS Impedance is 16 ohms, and power rating is 35 watts. Measures 29" H x 23" W x 17½" D, and is constructed of veneer-surfaced plywood, ¾" thick. Easy to build! Shpg Wt. 80 lbs.

MODEL SS-1B $99.95



RANGE EXTENDER

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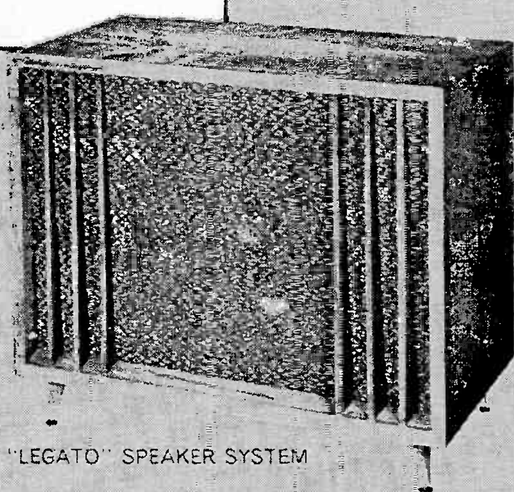
HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT

The fine quality of the Legato Speaker System Kit is matched only in the most expensive speaker systems available. The listening experience it can bring to you approaches the ultimate in esthetic satisfaction.

Frequency response is ±5 db 25 to 20,000 CPS. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high-frequency channel into phase with the low-frequency channel to eliminate peaks or valleys at the crossover point. This is one reason for the mid-range "presence" so evident in this system design.

The attractively styled "contemporary" enclosure emphasizes simplicity of line and form to blend with all furnishings. Cabinet parts are precut and predrilled from ¾" veneer-surfaced plywood for easy assembly at home. Impedance is 16 ohms. Power rating is 50 watts for program material. Full, smooth frequency response assures you of outstanding high fidelity performance, and an unforgettable listening experience. Order HH-1-C (birch) for light finishes, or HH-1-CM (mahogany) for dark finishes. Shpg. Wt. 195 lbs.

MODELS HH-1-C or HH-1-CM $325.00 each



"LEGATO" SPEAKER SYSTEM

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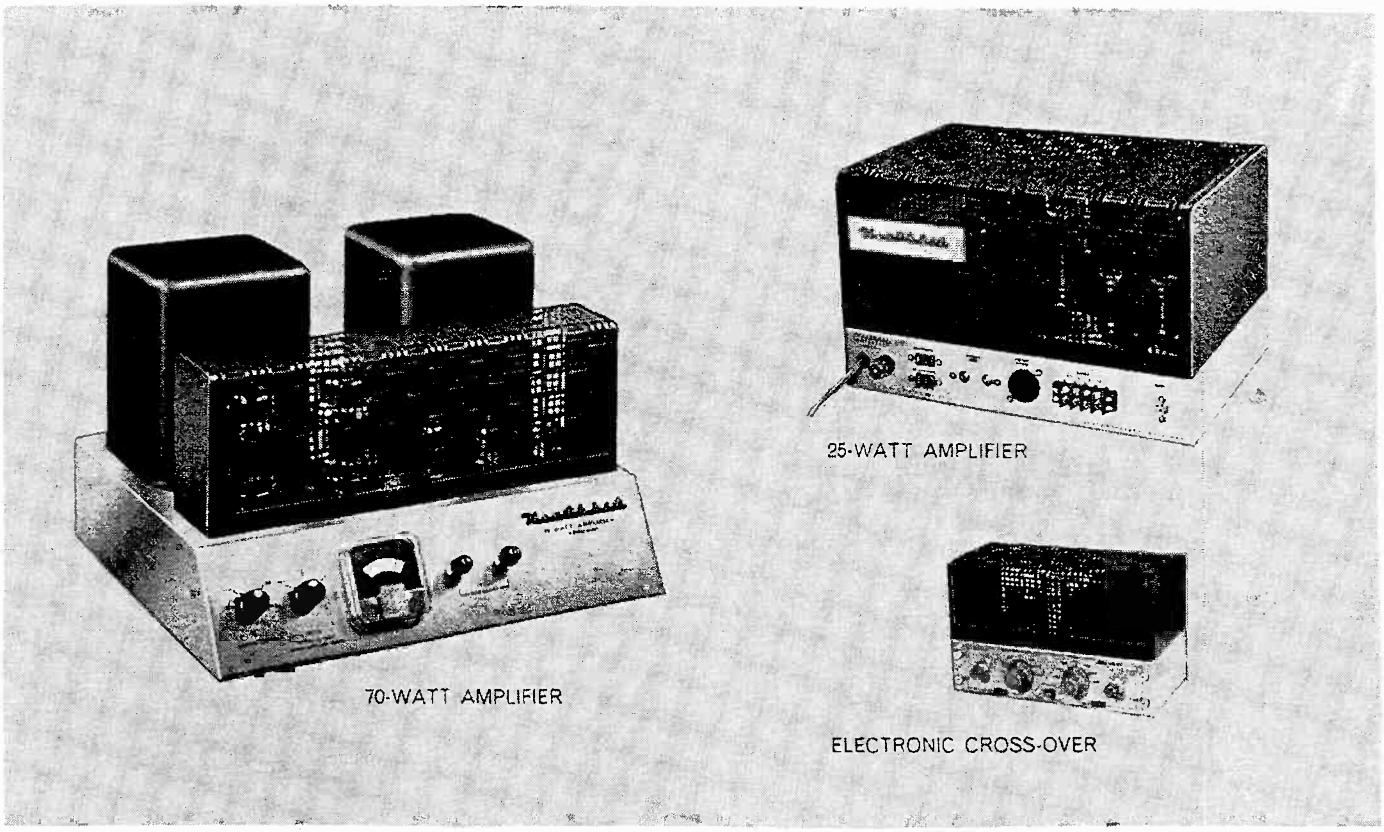


easy-to-build designs by HEATH *insure*

You get more comprehensive assembly instructions, higher quality circuit components, and more advanced design features, when you buy HEATH hi-fi!

HEATHKIT 70-WATT HIGH FIDELITY AMPLIFIER KIT

This new amplifier features extra power reserve, metered balance circuit, variable damping, and silicon-diode rectifiers, replacing vacuum tube rectifiers. A pair of 6550 tubes produce full 70-watt output with a special-design Peerless output transformer. A quick-change plug selects 4, 8 and 16 ohm or 70 volt output, and the correct feedback resistance. Variable damping optimizes performance for the speaker system of your choice. Frequency response at 1 watt is ±1 db from 5 CPS to 80 KC with controlled HF rolloff above 100 KC. Harmonic distortion at full output less than 2%, 20 to 20,000 CPS, and intermodulation distortion below 1% at this same level. Hum and noise are 88 db below full output. Variable damping from .5 to 10. Designed to use WA-P2 preamplifier. Express only. Shpg. Wt. 50 lbs. **MODEL W-6M $109.95**

HEATHKIT 25-WATT HIGH FIDELITY AMPLIFIER KIT

The 25-watt Heathkit model W-5M is rated "best buy" in its power class by independent critics! Faithful sound reproduction is assured with response of ±1 db from 5 to 160,000 CPS at 1 watt, and harmonic distortion below 1% at 25 watts, and IM distortion below 1% at 20 watts. Hum and noise are 99 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8 and 16 ohms. Employs KT66 tubes and Peerless output transformer. Designed to use WA-P2 preamplifier. Express only. Shpg. Wt. 31 lbs. **MODEL W-5M $59.75**

HEATHKIT ELECTRONIC CROSS-OVER KIT

This device separates high and low frequencies electronically, so they may be fed through two separate amplifiers driving separate speakers. The XO-1 is used between the preamplifier and the main amplifiers. Separate amplification of high and low frequencies minimizes IM distortion. Crossover frequencies are selectable at 100, 200, 400, 700, 1200, 2000, and 3500 CPS. Separate level controls for high and low frequency channels. Attenuation is 12 db per octave. Shpg. Wt. 6 lbs. **MODEL XO-1 $18.95**

HEATHKIT W-3AM HIGH FIDELITY AMPLIFIER KIT

Features of this fine Williamson-type amplifier include the famous Acrosound model TO-300 "ultralinear" transformer, and 5881 tubes for broad frequency response, low distortion, and low hum level. Response is ±1 db from 6 CPS to 150 KC at 1 watt. Harmonic distortion is below 1% and IM distortion below 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Provides output taps of 4, 8 or 16 ohms impedance. Designed to use WA-P2 preamplifier. Shpg. Wt. 29 lbs. **MODEL W-3AM $49.75**

HEATHKIT W-4AM HIGH FIDELITY AMPLIFIER KIT

A true Williamson-type circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can give you fine listening enjoyment with a minimum investment. Uses 5881 tubes and a Chicago-standard output transformer. Frequency response is ±1 db from 10 CPS to 100 KC at 1 watt. Less than 1.5% harmonic distortion and 2.7% intermodulation at full 20 watt output. Hum and noise are 95 db below full output. Transformer tapped at 4, 8 or 16 ohms. Designed to use WA-P2 preamplifier. Shipped express only. Shpg. Wt. 28 lbs. **MODEL W-4AM $39.75**

by RICHARD D. KELLER

book reviews

Transistor Circuits and Applications

John M. Carroll; pub. by McGraw-Hill Book Co., New York; 283 pages; $7.50.

This book consists of reprints of 106 feature technical articles that appeared in *Electronics* Magazine during the period from 1950 to 1956. It gathers in one place many authoritative articles which should be of value to circuit designers and engineers, and some which are simple enough in scope to be of benefit to amateur experimenters and hobbyists. All the basic amplifier, oscillator, pulse, and switching circuits are shown with typical component values; and numerous applications of transistors to home-entertainment, military, broadcasting, communications, computing, control, industrial, scientific, and medical equipment are described.

Operating characteristics of some 200 commercially available transistors are listed, although, as in most other transistor books today, the list is considerably behind the times (listing JETEC-registered transistors only as high as the already outdated 2N137) due to the introduction of many new types in recent months.

The engineering level and degree of competence of these articles vary considerably. Also, data in earlier articles (which are not identified herein as to date of publication) are now mostly of historical interest.

The volume should be of primary interest to design engineers who desire a compact source of *Electronics* articles, but the home experimenter will still find Lou Garner's *Transistor Circuit Handbook* his best bet.

Resonant Circuits

Alexander Schure, ed.: pub. by John F. Rider Publisher, Inc., New York: 64 pages: $1.20, paper-bound.

Another in the well-written Electronic Technology Series, this work falls into Rider's Group 1 category of simplified booklets covering the electrical bases for electronics. These books are simplified to the extent that almost any beginner can obtain excellent insight into the subject covered, but even advanced engineers will often find that some stumbling block in their previous thinking on the subject is cleared away by the straightforward presentation.

In *Resonant Circuits*, simplified mathematics is used to the extent necessary for an understanding of both parallel and series resonant circuits, as well as resonant coupled circuits and transmission lines with distributed constants.

Perhaps some day the contents of this series of booklets can be combined into an ideal textbook for first-year students. With the background on basic electrical and electronic concepts presented as clearly as it is in these booklets, a student could quickly progress to more advanced engineering and mathematical concepts with a minimum of confusion and misunderstanding.

Understanding Hi-Fi Circuits

Norman H. Crowhurst; pub. by Gernsback Library, Inc., New York; 224 pages; $5.00, cloth-bound; $2.90, paper-bound.

There's lots of good solid material in this book. Most of it, of course, is strictly for the advanced hobbyist with plenty of technical savvy, particularly the hobbyist or engineer interested in audio design and experimental work. To such a person, it offers hours of illuminating reading. For instance, comparisons are made between many types of output circuits, including triode, pentode, tapped screen, cathode follower, unity coupled, and others, with breakdowns of the advantages and disadvantages of each.

Similar comparisons are made concerning negative and positive feedback circuitry; damping and stability margins; the many types of inverter and driver stages; input circuits with relation to noise, hum, microphonics and distortion; stage matching; equalization; speakers and crossover networks; loudness and volume controls; and various types of tone-control circuits.

It should be noted that the author has not made this a mathematical or engineering text, but, rather, he has used a discussion type of approach in analyzing and comparing the many basic types of audio circuits which have been evolved up to the present time. As in his series of articles in AUDIOCRAFT, he has utilized charts, curves, and graphs in an effective over-all format.

Transistor Circuit Engineering

Richard F. Shea, ed.; pub. by John Wiley & Sons, Inc., New York; 468 pages; $12.00.

This book deservedly takes its place beside the other Shea works, *Principles of Transistor Circuits* and *Transistor Audio Amplifiers*, as a standard text and reference in the transistor field. The coauthors are members of the General Electric Electronics Laboratory at Electronics Park in Syracuse, New York. All are top authorities in their fields.

The book was prepared to show how transistor theory can be put to work in typical circuits in just about all potential fields of application, as in audio and DC amplifiers, tuned amplifiers, RF and video amplifiers, oscillators, modulators, detectors, switching circuits, regulated power supplies, etc. Typical circuits are designed step by step to show the major points of consideration. The importance of proper biasing and bias stabilization is given due emphasis, and basic transistor characteristics and curves are covered in considerable detail.

Transistor Circuit Engineering is right up-to-date and should be welcomed by any design engineer. A number of typical problems at the end of each chapter will encourage its use as a college text as well.

Frequency Modulation Receivers

J. D. Jones; pub. by Philosophical Library, Inc., New York; 114 pages; $6.00.

This British text concentrates entirely on the reception of FM, with stage-by-stage descriptions of the principles and operation of frequency-modulation receivers.

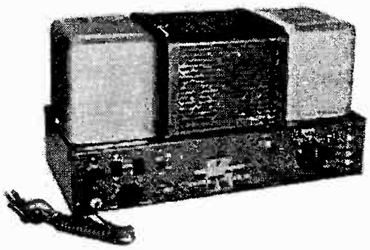
The work goes into considerable mathematical detail concerning the choice of circuit values, and, after covering each stage thoroughly, winds up with the schematic of an FM superheterodyne receiver. All in all, a bit stilted and unwieldy.

Audionews

ACROSOUND AMPLIFIER KIT

The Acrosound *Ultra-Linear II* is a 60-watt power amplifier supplied in kit form with all critical wiring preassembled on a printed-circuit board. A full-choke, capacitor power supply is used, and tubes are operated well within their ratings.

The heart of the amplifier is the new Acrosound TO-600 output transformer which combines low leakage reactances between windings with a novel feedback winding providing a degree of feedback relatively unaffected by the reflected impedance of the speaker system.



Ultra-Linear II 60-watt power amplifier.

Rated output power of the Ultra-Linear II is 60 watts, 120 watts on peaks. IM distortion is said to be less than 1% at 60 watts for any standard combination of test frequencies. Harmonic distortion is said to be less than 1% at any frequency between 20 cps and 20 Kc at power output within 1 db of 60 watts. Frequency response, according to the manufacturer, is flat within 1 db from 18 cps to 30 Kc at 60 watts, and, at 1 watt, flat within 1 db from 5 cps to 100 Kc. Hum is stated to be 85 db below rated output.

The price of the Ultra-Linear II kit is $79.50. The amplifier is also available completely assembled for $109.50.

NEW MAGNETIC TAPE

A new magnetic tape which is said to reduce print level by 8 db and increase high-frequency response has been announced by Minnesota Mining and Manufacturing Co. Called Scotch brand magnetic tape *No. 131 Low Print*, it is stated by the manufacturer to have the lowest print level of any magnetic tape on the market.

Print, the firm explained, is the phenomenon by which a recorded signal on tape will slightly magnetize the adjacent layer of tape on the reel. The result is that, under the most critical conditions, a faint echo of the signal can be heard on playback at a high gain level.

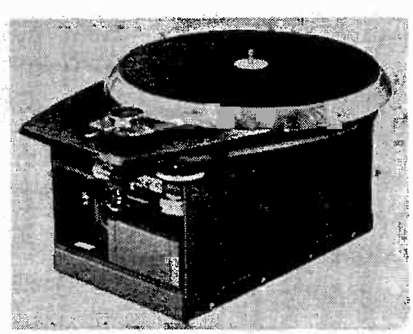
Although print rarely, if ever, is detectable in most tape-recording applications, it may be a problem in recordings made on highest-quality professional recorders where the noise level of the machine is exceptionally low.

The new tape comes in a grey box marked *for professional use*, and can be identified by a gold *Low Print* seal on the cover.

ELECTRONIC-DRIVE TURNTABLE

A new high-fidelity 4-speed turntable was announced recently by Fairchild Recording Equipment Company. Unique to the *Model 412-4* turntable is the use of a hysteresis-synchronous motor to provide "variable" speed: 16⅔, 33⅓, 45, and 78 rpm. Fairchild achieves variable speed from a hysteresis motor through the use of a new electronic drive unit, an accurate variable-frequency electronic power source which drives a hysteresis motor at 30, 60, 81, or 141 cps. The desired frequency is selected by a single control switch. Adjustments are provided for varying the turntable speed ±3%. Voltage and frequency fluctuations are reported not to affect the operation of the electronic drive. The unit will function normally on 50 or 60 cps current.

A novel feature of the unit is that it can be purchased without the electronic drive. This model, the *Model 412-1*, operates at one speed, 33⅓ rpm.



The 412-4 frequency-controlled turntable.

The electronic drive can be added to the 412-1 to convert it to 4-speed operation.

The price of the Model 412-1 single-speed turntable is $79.95. The 412-4 4-speed turntable is priced at $159.95. The electronic drive is available separately for $84.

FULL-RANGE SPEAKER

The new Stephens *Trusonic 80FR* is a full-range 8-inch loudspeaker with a frequency response said to be from 40 to 15,000 cps. Free-air resonance of the 80FR is 50 cps, according to the manufacturer. It can handle 20 watts continuous power and 50 watts peak. A newly designed cone is said to reduce spurious resonances.

80FR full-range eight-inch loudspeaker.

Impedance of the 80FR is 16 ohms; its magnet weight is 1 lb. The size of the speaker is 8¼ in. in diameter by 4¼ in. deep. The net price is $31.50.

TRANSISTOR RECEIVER KIT

A self-powered, portable, transistor receiver kit has recently been announced by the J. W. Miller Company. This receiver, the Miller *Model 555*, is said to deliver four-transistor performance from a circuit employing only three transistors and two crystal diodes.

The receiver uses one transistor as a combined mixer and oscillator stage. The second transistor is used in a special "reflexed" circuit which combines the functions of an IF amplifier and an audio amplifier. One of the crystal diodes functions as a detector, while the second is employed in an automatic-gain-control circuit. The remaining transistor functions as an audio power amplifier, delivering approximately 25 mw to the 2¾-inch PM speaker.

The receiver requires no external antenna or power source. Power is supplied

This receiver kit uses three transistors.

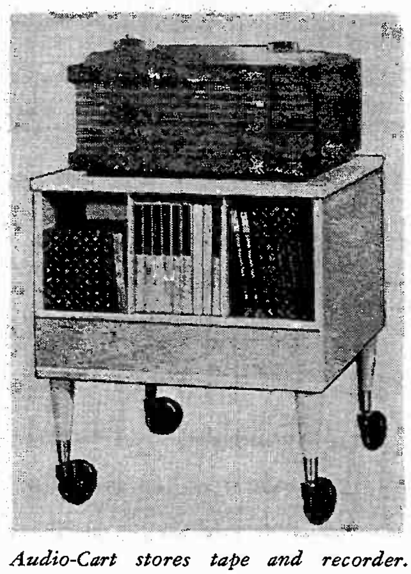
by a miniature 9-volt battery which will operate the receiver for about 300 hours. All components are mounted on a printed-circuit board. All coils and transformers are adjusted at the factory. The kit is supplied with detailed step-by-step instructions and pictorial diagrams.

Price of the Model 555 transistor receiver kit is $29.50.

AUDIO-CART

The *Audio-Cart*, a stand to hold tape recorders at desk height, has recently been placed on the market by Universal Woodcrafters, Inc.

The Audio-Cart is constructed of furniture veneer, and has 3-inch wheels so that it will roll easily. There are three front compartments for storing 27



Audio-Cart stores tape and recorder.

reels of tape. A rear accessory compartment provides additional storage room for microphones, extra tape reels, extension cords, and other associated equipment.

The list price of the Audio-Cart is $29.95.

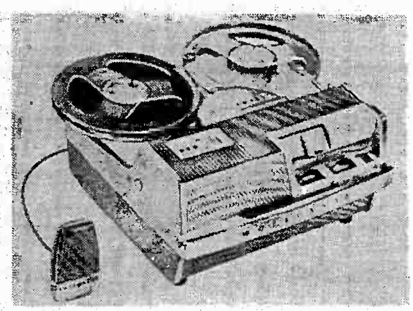
LISTENERS' GUIDE

Classical-music listeners in the Los Angeles area can now subscribe to a new program guide. Entitled *Music Listeners's Guide*, the new publication's coverage includes programming of classical music on radio (both FM and AM), opera on television, and a listing of live concerts and recitals.

Subscriptions to *Music Listener's Guide* are $3.00 a year; single-copy price is 35¢. For information, write to The Music Listener, P. O. Box 147, North Hollywood, Calif.

DUAL-SPEED TAPE RECORDER

The *Model 1500* dual-speed tape recorder recently introduced by the Wollensak Optical Company employs miniaturized components and all-metal construction. The unit measures 6½ in. by 10¼ in. by 11¾ in., and weighs 18 lbs. It accepts 7-inch reels. Tape speeds are 7½ ips and 3¾ ips.



Wollensak miniaturized tape recorder.

Frequency response of the 1500 is said to be flat, ±3 db, from 40 to 15,000 cps at 7½ ips, and flat, ±3 db, from 40 to 8,000 cps at 3¾ ips. At both speeds, signal-to-noise ratio is —48 db, wow and flutter less than 0.3%, and over-all distortion less than 0.8%, according to the manufacturer.

Complete with ceramic-type, wide-range microphone, two reels (one with tape), and cords, the Wollensak 1500 dual-speed tape recorder retails at $189.50.

For more information about any of the products mentioned in Audionews, we suggest that you make use of the Product Information Cards bound in at the back of the magazine. Simply fill out the card, giving the name of the product in which you're interested, the manufacturer's name, and the page reference. Be sure to put down your name and address too. Send the cards to us and we'll send them along to the manufacturers. Make use of this special service; save postage and the trouble of making individual inquiries to a number of different addresses.

MIRAGRIP RECORD HANDLER

With the increasing sensitivity of microgroove records and high-fidelity reproduction equipment, even the slightest fingerprint on the playing surface of a record may cause noise and distortion. Designed to prevent such occurrences,

Record handler prevents fingerprints.

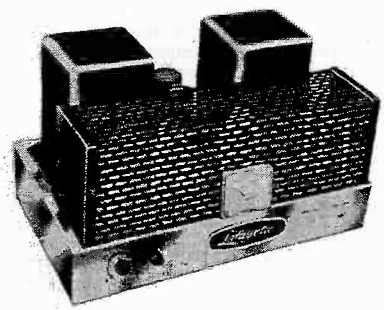
the Clarovox *Miragrip* record handler picks up records easily and firmly, with no danger of slipping. The plierslike design is such that the Miragrip can be conveniently used with one hand.

The metal handles and body are chrome plated and the rubber gripping sleeves are available in a variety of colors.

The Miragrip is manufactured by Clarovox Products of Coventry, England, and is available in the United States through Ercona Corp. The Canadian distributor is Astral Electric Co., Ltd., Toronto.

LAFAYETTE 70-WATT AMPLIFIER

Lafayette Radio is now producing a 70-watt, wide-range amplifier designed by Victor Brociner. The amplifier is said to be capable of producing 70 watts continuously, 80 watts momentarily, and instantaneous peaks of 160 watts. IM distortion, according to the manufacturer, is less than 1.5% at 70 watts at 60 and 7,000 cps; harmonic distortion is less than 2% within 1 db of 70 watts



Lafayette's new 70-watt amplifier kit.

from 20 to 20,000 cps.

The amplifier is equipped with a Chicago output transformer. Output impedances are 4, 8, and 16 ohms.

The amplifier is available in kit form as the *KT-400* at $69.50, or fully wired as the LA-70 at $94.50.

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By CHARLES FOWLER, Publisher, AUDIOCRAFT Magazine

Whether your budget is small or large, whether you are a beginner or a devotee from way back, this complete and definitive guide can help you get the most enjoyment out of your high-fidelity system.

Here is the practical expert advice needed by everyone who has, or expects to have, a high-fidelity system. Starting with an introduction to sound, the author then describes the various links in the hi-fi chain, explaining their features and specifications so as to provide the most helpful criteria for evaluating, and for selecting and matching components. $4.95 **234**

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Readers' Forum

Gentlemen:
We wish to call your attention to page 10 of your August issue. On this page (your "Audionews" department) there appears an announcement of a new 60-watt Ultra-Linear amplifier kit, featuring our Acrosound TO-330 output transformer, to be sold by Lafayette Radio Corp. This announcement contains an error.

Please be advised that we are not supplying our TO-330 to Lafayette. At the present time, we are only supplying the TO-330 to one manufacturer: EICO. We would appreciate your advising your readers of this fact.

Jack Snyderman
Sales Manager
Acro Products Co.
Philadelphia, Pa.

Latest information from Lafayette is that the kit has been completely redesigned. It is rated at 70 watts, has built-in metering facilities, and utilizes a Chicago output transformer. Full details are published on page 13. — ED.

Gentlemen:
Page 13 of the August issue invites comment on cover design. I must agree with Mr. Cleveland of Troy; the cover is too crumby for so fine a magazine.

Why not use a full-cover photo bled on four sides and a much smaller sig cut? Eliminate those hideous block-letter teasers on articles which are so packed together they defeat their purpose in actually being hard to read at a glance. If they must be used to boost stand sales, a different typography cut in like the sig would help.

The present cover counters all objectives of good modern design: cleanness, simplicity, so many little areas.

Keep up the editorial good work.

E. E. Hoaglan
Omaha, Nebr.

Gentlemen:
I agree entirely with Mr. Eugene I. Cleveland's well-put opinion of your new cover. "Cheap, gaudy, and commercialized" describes it exactly. The sad thing is that it isn't even new, but an inferior variation of the old one.

Title, date, price, the picture and its caption, and the three boxes announcing the feature articles are located generally as before, but the proportions have been spoiled. The picture and the

Continued on page 46

EDITORIAL

A FEW years ago there began to appear in the catalogue specifications for FM tuners a mysterious reference to a "Multiplex output," a "Detector output," or some similar added ingredient. If any word of explanation was given, it usually involved the phrase, "for future FM multiplex stereo broadcasts." The number of tuners now in use which have these special output jacks is certainly very high — but the number of opportunities to use them has been certainly very low, if not indeed zero.

Well, what are these things for? And are they potentially useful, or just a sales gimmick like the "TV sound" input jacks that appeared suddenly on millions of radios when television was just a bright glow on the horizon? To get answers for these questions, let's look at FM multiplexing in its present state of development.

In frequency modulation, as every reader of this magazine is aware, the amplitude of the radio-frequency carrier wave is held constant, and its frequency is varied in accordance with the audio modulation. The frequency of the audio determines the *rate* at which the carrier is varied around its center frequency; the amplitude of the audio determines how far away from center frequency the carrier deviates. Theoretically, the limit on carrier deviation is determined only by the carrier center frequency, but practically the 100% modulation point is taken as ±75 Kc from the carrier center frequency. This determines the maximum dynamic range of the system: 75-Kc deviation of the carrier will produce more signal output from a receiver than, say, 50-Kc deviation, so that the former will be correspondingly higher above the system noise level.

In fact, the potential dynamic range is so great that FM subcarrier channels can be added to the main carrier without serious degradation of the signal-to-noise ratio. An ultrasonic frequency (41 Kc, for example) is set up as a subcarrier, and this is frequency-modulated by a second audio signal. Then this ultrasonic FM subcarrier frequency-modulates the main radio-frequency carrier in the same way as the primary audio channel. At the receiver, the main carrier is amplified and detected in the usual way. But the output of the main detector now contains not only the audio intelligence of the main channel, but the ultrasonic subcarrier as well, which is frequency-modulated by the second audio channel signal. The second channel cannot be heard at this stage, of course; it is necessary to feed the subcarrier to another FM detector circuit tuned to the ultrasonic carrier frequency. The output of *this* detector contains the audio intelligence of the second channel.

Two subcarrier channels can be added to the main carrier without significant loss of quality, making it possible to broadcast three separate programs simultaneously from a single FM transmitter. This process is called FM multiplexing. And the purpose of the "Multiplex output" jack is to feed an ultrasonic subcarrier from your tuner's detector to an external subcarrier detector, on these two premises: that FM stations will eventually broadcast stereo programs using the main channel and one subcarrier channel, and that the requisite subcarrier-detector units will be commercially available.

Several FM stations are using a subcarrier to furnish background music for restaurants, stores, and other businesses of similar nature. The regular station commercials are deleted, and the station charges a fee for this service. A few FM stations have found a solution to their economic troubles in this way; it is reasonable to suppose that others will do so. At least one station — WGHF-FM, in Brookfield, Connecticut — is making tentative, experimental stereo broadcasts via FM multiplex.

It is reasonable to ask why, if three channels are available, two are not used regularly for stereo broadcasts and one for the background-music service. There are some good reasons: first, multiplexing equipment is expensive to the stations, and it would be unreasonable to expect them to make further substantial investments in nonprofit-making equipment before they get on their pecuniary feet. Second, no adapter units are yet available. Complete multiplex receivers are made for the background-music service, but they are quite expensive and unnecessary, and may not be available to home users. Third, if simple adapter units *were* available to everyone, there would be nothing to prevent piracy of the background-music service by any commercial establishment. Standards and operating procedures will have to be agreed on to prevent this before multiplex stereo broadcasting can be established on a large scale.

To sum up, it seems likely that your tuner's "Multiplex output" may eventually be put to good use — but not for some time yet. Perhaps you can shorten the interval of waiting by writing to local FM outlets; they are glad to receive expressions of interest and suggestions for programming. — R.A.

The Electronic Organ: King of Kits

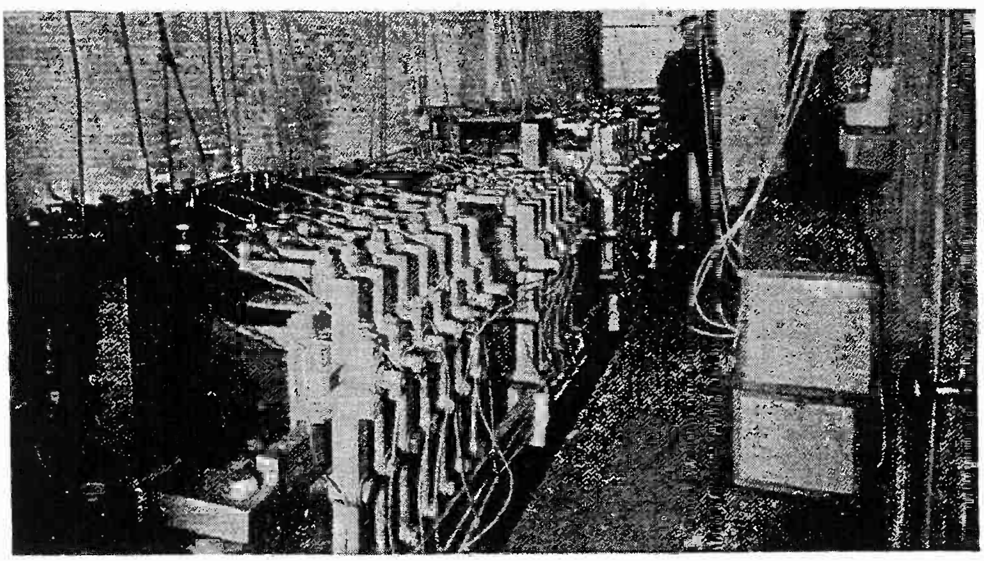
PART I: Electronic Instruments, Past and Present

BUILDING an electronic organ is not a task to be undertaken lightly. When it was first suggested that someone on the staff of AUDIOCRAFT construct an electronic organ from a kit, the response to the call for volunteers was less than overwhelming. While most of us here are fairly experienced kit builders (by necessity as well as by inclination), building an electronic organ from a kit seemed such an ambitious project that we thought twice before taking on the job. When I decided to come to the rescue of the magazine's honor, I had no previous experience nor any special talent that particularly qualified me for the project. My knowledge of electronic-organ lore was next to nil. About the only things to be said in my favor were that I had built some kits successfully and that I was optimistic.

Let me say right here at the beginning of the article that I don't think an electronic-organ kit makes a good starting point for the amateur kit builder just launching his career. If you have never used a soldering iron, slipped spaghetti over a lead, or learned how an electric current behaves when it meets a resistor, a capacitor, or an inductor, you'd better do some initial experimenting on a device less complicated and less expensive than an electronic organ.

With the welter of things going on in the world today, it's a wonder that we know as much about as many things as we do. I confess, though, that a knowledge of electronic musical instruments was one of the things that had escaped me in the confusion. When they had been invented and by whom, what forms they had taken, and the state of their current development were unknown quantities. Once I became engrossed in the work of assembling an electronic organ for myself, however, these questions gradually assumed more importance. To get off to a proper start, then, let's look very briefly at the history of electronic musical instruments. Readers interested enough in the subject to pursue it further will find a short bibliography at the end of the last installment.

Fig. 1. The alternators (tone generators) for the Telharmonium. They had to be large since this was before the time of vacuum tubes and vacuum-tube amplifiers.



Culver Service

Beginnings

One of the first instruments to produce music electrically was the Telharmonium. invented in 1903 by Thaddeus Cahill. Dr. Cahill is perhaps better known for his invention of the electric typewriter, but the Telharmonium is impressive in its own right. The instrument consists of a number of alternating-current generators (Fig. 1), each producing a sine wave of a different frequency. A keyboard (Fig. 2), similar to that of an organ, enabled the player to combine

the outputs of whatever generators he wished to produce musical tones of different pitches. The composite current from the generators passed through a telephone receiver, and the receiver's diaphragm produced sound waves corresponding to the frequency of the electric current. Any number of receivers could be connected to a single keyboard, and it was Dr. Cahill's plan to pipe the music into the homes of subscribers, using an arrangement similar to that of the telephone system.

It was not until after the vacuum tube was invented that any additional significant progress was made in the development of electrical musical instruments; but, once the vacuum tube became available, things began to happen with comparative rapidity. Instruments were developed along two lines: one type can be designated *electromechanical*, and the other, *electronic*.

Electromechanical Instruments

Tone, in electromechanical instruments, is produced by mechanical means. In the electronic carillon, for example, tuned metal bars are struck and caused to vibrate by hammers. Some electromechanical instruments retain sounding boards; others do not; but, in all cases, energy is generated by mechanical means and is transformed into electric current and amplified by a device employing vacuum tubes. After amplification, the electrical impulses are changed back into sound by means of loudspeakers.

The Superpiano, developed in 1927 by E. Spielmann, an Austrian, was the first of more serious attempts in this direction. The keys of the Superpiano act on lamps, the light of which passes through rotating discs and is transformed into electrical impulses by means of photoelectric cells.

An American contribution to the electromechanical line of development is the Rangertone of Richard H. Ranger. This instrument employs electrically controlled tuning forks as sound generators.

Courtesy R. A. Moog

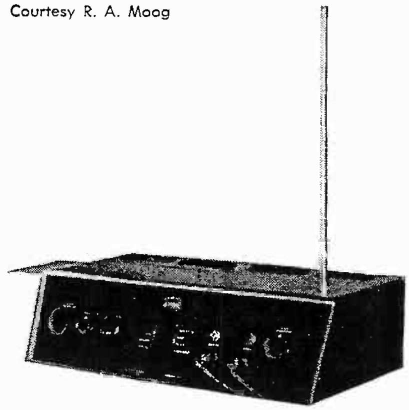


Fig. 3. The modern Thérémin. It's prototype was first electronic instrument.

Here again, sound energy developed by the tuning forks is transformed into electrical energy, amplified, and changed back into sound by loudspeakers.

Electronic Instruments

Tone, in electronic instruments, is generated by an oscillating electric circuit with a distinct frequency. Some electronic generators oscillate at frequencies well above the audible range, producing audible frequencies as beats or difference tones; others oscillate at the audio frequency desired.

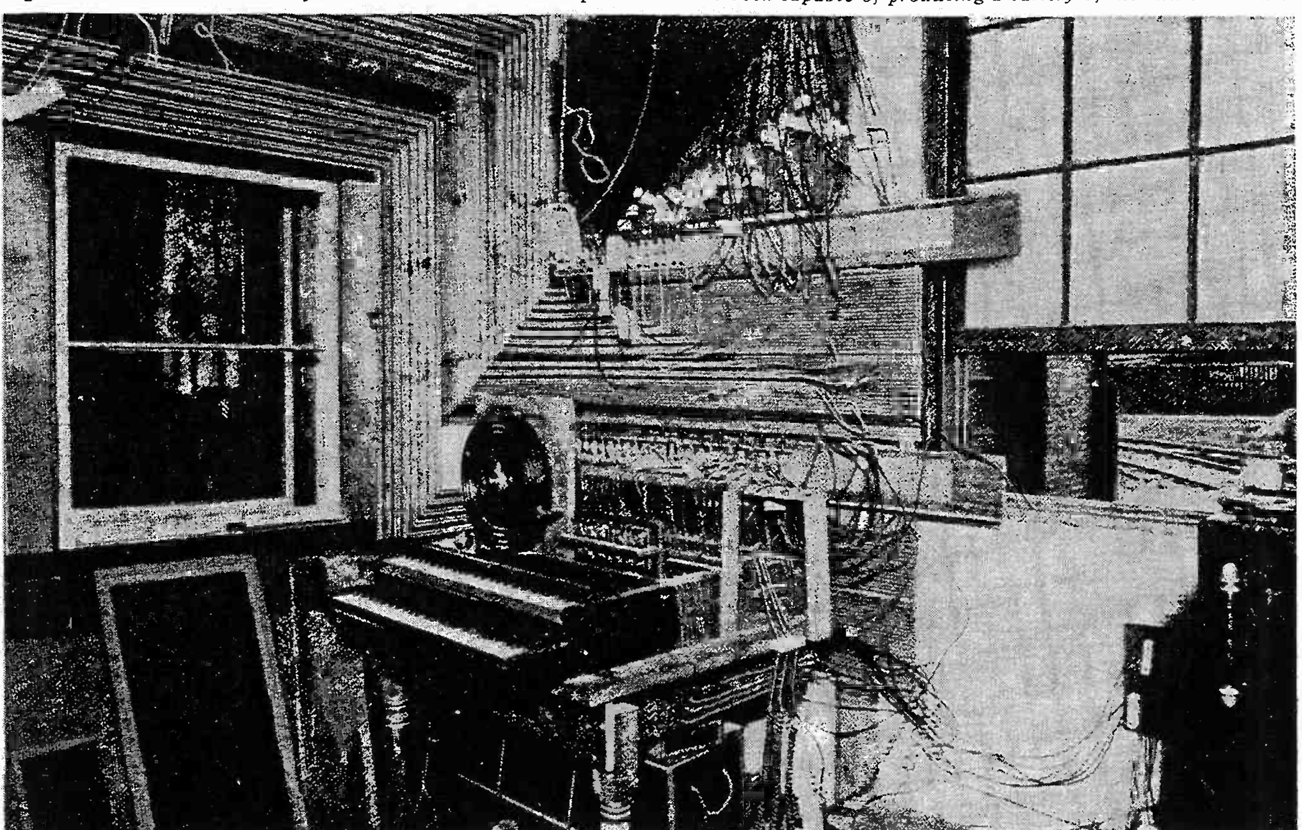
The Thérémin[1], also known as the Théréminvox and the Aetherophone (Fig. 3), the first truly electronic instrument, was invented in 1924 by Dr. Leon

Continued on page 34

[1]A description of the Theremin and its modern version is given in: Robert Moog, "Music from Electrons," AUDIOCRAFT I (June 1956), p. 16.

Fig. 2. The Telharmonium's keyboard. The instrument is reported to have been capable of producing a variety of instrumental tones.

Culver Service



TRANSISTORS *in Audio Circuits*

by PAUL PENFIELD, JR.

VIIa: Transistor Input Stages

This part of the series represents a turning point. Until now the material has been mostly theoretical: the physics and mathematics of transistors in audio circuits. Generally speaking, from now on the more practical aspects will be emphasized.

To be a good circuit designer one must know the fundamentals discussed in previous articles of the series. That is, after all, why they were presented. However, the reader who was either unable or unwilling to read the first six parts, or who is not sure he has understood it all, will be able to follow the more practical installments. This series was written so that a knowledge of the preceding material would be helpful, although it is not absolutely essential.

THE first stage in a transistor amplifier is quite important. In practice many types of audio input signals are encountered, from many kinds of sources, and for best operation the input stage should be designed to fit the particular source.

Transducers

Any device that produces an electrical signal in response to some externally applied stimulus is an input transducer. Familiar audio transducers include microphones, phono cartridges, magnetic-tape heads, photocells, etc.

All transducers are characterized by an internal impedance, Z_g, and a certain "average" output voltage, E, when left open-circuited. That is, all transducers can be represented, over the frequencies of interest in the audio range, by an equivalent circuit such as that shown in Fig. 1. The only differences among the various types of transducers, as far as AC analysis is concerned, are those of internal impedance or value of the equivalent signal source.

For example, a dynamic microphone might be represented as a voltage source of .001 v (one millivolt) in series with a resistor of 150 ohms. Although this is not valid for an extended frequency range, it may be fairly accurate over the audio range.

Isn't the value of the voltage generator dependent on how loudly you speak into the mike? The answer, of course, is "yes," and indeed the *sensitivity* of the microphone is determined by this relationship. But for our purposes we assume that the person is speaking with average loudness, and similarly, the phonograph cartridges are playing average records.

In practical cases, finding this equivalent circuit involves carefully reading the specifications of the transducer, determining what reference level and what notation is being used, and relating this to the sound intensity (or record-groove displacement or velocity) expected. Or, more simply, the open-circuit output voltage can be measured in practical cases, and tests made to determine the magnitude and nature of the internal impedance.

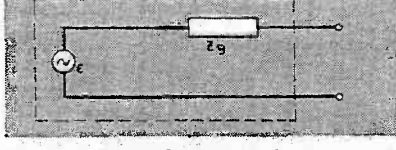


Fig. 1. Equivalent transducer circuit.

Limitations of the Transistor

The AC sensitivity of an amplifier is always determined by noise. In Part III of this series some of the concepts of transistor noise were introduced. In particular, the noise figure (NF) was described as the ratio of amplifier noise output to that part of the noise output produced by the generator resistance. The noise figure is a good means for comparing two transistors for noisiness, but the quantity of interest is the signal-to-noise ratio, S/N.

The relation is simple, however. S/N is equal to a quantity characteristic of the transducer (and not of the amplifier), divided by the amplifier noise figure. If these numbers are given in decibels, as is customary, the second should be subtracted from the first.

The noise figure, then, should be minimum if the highest possible signal-to-noise ratio is desired. With this in mind, we will see how to bias the transistor for least noise figure.

Besides the noise problem, the designer is often faced with a problem of providing for operation with least power drain from the batteries. Biasing so as to avoid thermal drifts — that is, providing bias stabilization — is important, as was discussed in Part IV. Biasing for least power loss is essentially a matter of cut and try: design a circuit, find the power drain, and if it is too high, change the circuit to reduce it. Almost always this means raising the stability factor, S, so here a compromise is necessary. Biasing of the first stage must be a compromise between these three requirements — low power drain, good stability, and low noise.

Biasing for Least Noise

The noise figure for typical junction transistors, customarily specified in terms of the 1,000-cps component, will range from as low as 3 db for very quiet transistors to 40 or 50 db for poor units. The characteristics of low-noise transistors are of most interest, since these will be the ones selected for use in an input circuit.

The noise figure depends on the generator resistance the transistor is connected to, and on the bias point (usually expressed in terms of emitter current and collector-to-base voltage); but strangely enough, it is not dependent to any significant degree on the configuration used. That is, for a given source resistance, and a given bias point, the noise figures for the three configurations — grounded-emitter, grounded-base, and

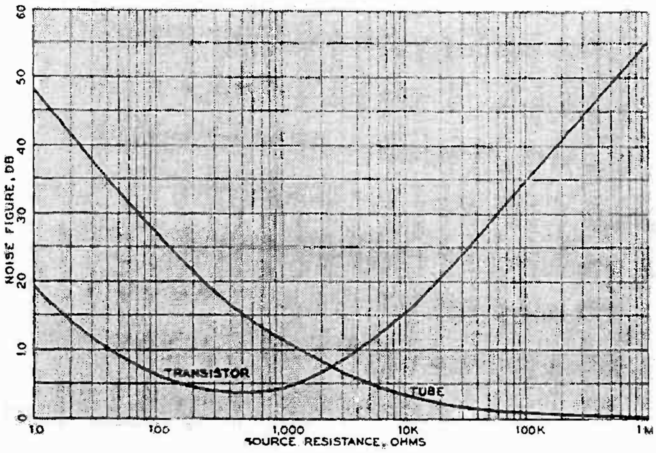
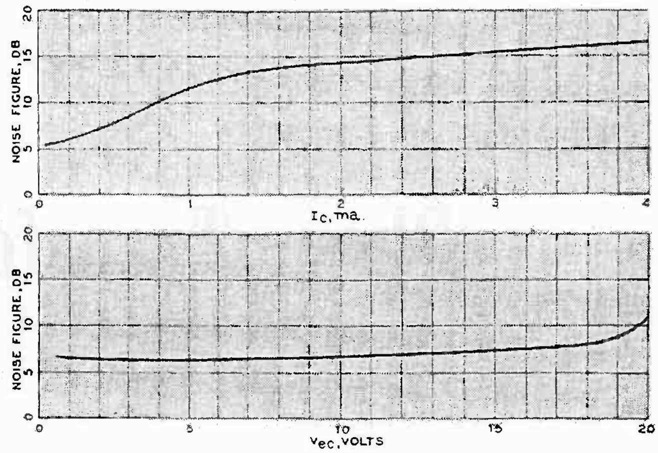


Fig. 2. The effect of source resistance on noise figure.



Figs. 3 (above) and 4. Bias point effect on noise figure.

grounded-collector — are roughly the same. Although this is a controversial point, it seems fairly well settled now. Choice of configuration is immaterial for the noise figure, give or take a couple of decibels.

The effect of source resistance on the noise figure is shown in Fig. 2. This graph, and the two that follow, were intended to be representative only; while they will not be exact for any given transistor, they do show the general trends. Graphs like these are usually available for commercial low-noise transistors.

Note that there is an optimum source resistance, at which the noise figure is minimum. The minimum is very broad, however, so the "best" resistance is not at all critical.

For comparison, the same sort of plot for a vacuum tube (a rather good low-noise type) is shown. It is clear that the transistor is advantageous for low-impedance transducers, such as tape playback heads, while the vacuum tube holds the edge for higher-impedance devices. Again, do not treat the curves too seriously. They show general trends only.

Figs. 3 and 4 show the effect of bias point on noise figure. In general, the less emitter current, the less noise. Various transistors have different curves, but generally, for a very high signal-to-noise ratio, use a low-current condition.

Fig. 4 shows that below roughly 10 volts there is little to be gained by any particular collector voltage bias. Some transistor types show a rise in noise figure at less than 1 volt; others do not.

These two conditions together imply that, to minimize noise problems, operation at low power is desirable. This concept of operating at low power has been carried to an extreme in the so-called "hushed amplifier," in which collector voltages are held to mere millivolts. Here ordinary transistors are operated in such a way that the noise is reduced considerably, at the cost of a severe loss in gain. However, signal-to-noise levels are comparable to, and often better than, those obtained with normal operation of special low-noise transistors.

With these general rules for choosing bias point with noise level, battery drain, and stability in mind, the requirements for various transducers can be examined.

Microphones

Crystal mike: for the first type of transducer, consider a crystal microphone. This has a source impedance of megohms, with an equivalent source voltage of perhaps .05 volt. Also, the source impedance is reactive, and, unless the microphone is connected to a high terminating resistance, the frequency response will be disturbed. Thus we have the problem of a generator which must work into a high impedance.

A choice must be made as to configuration. Recall from Part VI that the grounded-collector circuit has high input resistance, while the grounded-emitter circuit has medium input resistance. Since the noise figure will be the same for the two configurations, the choice is to be made on the bases of gain requirements and input resistance.

In the first place, the grounded-collector circuit is often hard to bias with much stability. If the high input resistance of this circuit is to be used, the bias resistors shunting the base must be higher than this. Furthermore, the input resistance is very dependent on the load resistor, and hence is not so stable as could be desired; if the load or any of the transistor parameters varied, the resistance seen by the microphone would change.

A simple alternative is to place a series resistor in the base lead (past the point where the bias is applied) of a grounded-emitter stage, to bring the input resistance up to that of the common-collector circuit. Then the value of input resistance will be almost constant, independent of parameter changes in the transistor, load changes, and temperature. Furthermore, neither the signal-to-noise ratio nor the gain suffers appreciably. The gain is the same because, as you will recall, the grounded-emitter and grounded-collector circuits have almost identical current gains, and here, if the resistance seen by the microphone is the same, the input current will be the same in the two cases. The noise figure will not suffer because, if the bias resistors in the second case are comparable to the input resistance of the grounded-emitter stage alone, the transistor is connected to a source impedance which is low. Thus, although the voltage appearing at the base of the transistor is far below that at the microphone, the noise factor (see Fig. 2) is correspondingly lower, or nearly so. The grounded-emitter circuit seems to be better in all ways, in spite of the fact that impedances are not matched.

In this case, neither the common-collector circuit nor the common-emitter circuit with the added resistor does a very good job. A better alternative is shown in Fig. 5 — a transformer is used.[1] The secondary impedance should be roughly the input impedance of the grounded-emitter stage, and the primary should be the resistance the microphone should see for correct frequency response, generally 250,000 ohms or more. This circuit provides the best gain and best signal-to-noise ratio, but offers the disadvantages of size, weight, cost, as well as the frequency limitations of the transformer.

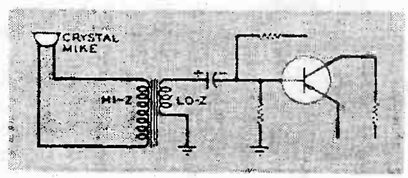


Fig. 5. Transformer-coupled input stage.

All in all, then, the best advice on crystal microphones is, "don't connect

Continued on page 36

[1]Fig. 5 and others to follow are meant to show only the input coupling method, and not necessarily the preferred method of biasing, except where indicated.

Phono-Transformer Switching

by HERMAN BURSTEIN

IN the design of electromechanical devices an advance in one direction often involves a sacrifice in another, and this holds true for phono pickups. Among the finest of present-day cartridges are those with the least output, sometimes as little as 1 mv at 1,000 cps for average recorded levels on a modern disc. Such a cartridge requires not only the usual preamplification, but also pre-preamplification by means of an input transformer, in order to obtain enough voltage to drive the rest of the audio system satisfactorily.

Few control amplifiers provide as much gain as the audiophile would like to have when using a pickup with extremely low output. Even when there is enough gain, an input transformer is desirable as a means of improving the signal-to-noise ratio. In other words, the transformer increases the ratio between the input signal and the noise and hum generated in the control amplifier, largely in the first phono preamplification stage.

The ESL Concert Series, a magnetic pickup of the moving-coil type, is an example of a cartridge with outstanding sound quality but with very low output voltage. This contrasts with magnetic pickups of the variable-reluctance variety, some of which produce as much as 34 db more signal, about 50 mv, under the same conditions. An input transformer is a virtual necessity with a cartridge such as the ESL.

However, installation of a transformer may well raise a problem for the audiophile who plays 78-rpm records extensively, as well as the long-playing types. Many persons are willing to invest in the cost of a fine cartridge for playing high-quality LP's but they often employ a less expensive pickup, with higher output and other different characteristics, for 78's. They are then faced with the problem of eliminating the input transformer when switching to the pickup used for 78's. This is necessary not only because of gain considerations, but because the input transformer is unlikely to match the second cartridge correctly, usually resulting in a *loss* of gain and a drop in high-frequency response.

Of course the input transformer can be added to or removed from the circuit by the expedient of manually changing cable connections each time that one switches cartridges. But this procedure is time-consuming, annoying, and not a very neat nor workmanlike answer to the problem. The satisfactory solution is to incorporate a switch in the audio control unit which will insert or delete the input transformer at will. Such a switch, at least at low levels, also has the advantage of permitting an A-B comparison between reproduction with and without the transformer; of course, when the switch is flipped so that the transformer is out, the gain of the control unit must be simultaneously turned up to produce the same level as with the transformer in.

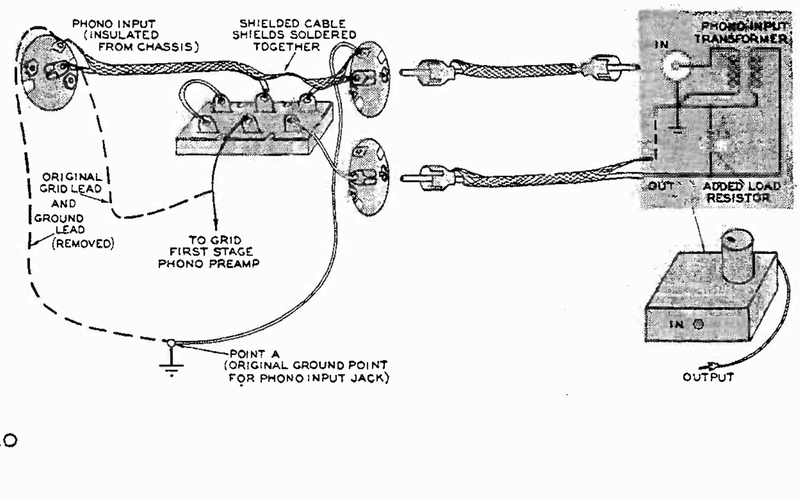
The illustration shows an arrangement I improvised for switching an ESL 301F input transformer in and out of the circuit. The hardware required was a double-pole double-throw switch, and two phono jacks for the shielded-cable connection to the input and output of the transformer. The switch is preferably of the slide type, make-before-break, in order to avoid thumps when switching. However, a toggle switch is easier to install, requiring a circular rather than rectangular cutout, and is satisfactory if you remember to turn the gain control down before switching. The switch can be installed either on the front or back panel, depending upon available room and convenience of access in use.

The phono jacks for making connection to the transformer were mounted on the rear panel. It is important that the ground side of these jacks be insulated from the metal panel in order to avoid a hum-producing ground loop; two different paths to ground behave like a turn of wire, picking up hum by induction in the presence of a 60-cps magnetic field produced by AC leads, transformers, etc. I used a double thickness of adhesive tape as an insulating material between the phono jacks and the rear panel. Holes for the jacks were drilled large enough for the metal casing of the jack to clear the panel adequately. The effectiveness of these insulating measures was then checked with an ohmmeter.

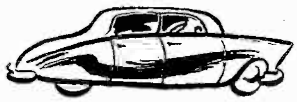
The ground terminal of the phono in-

Continued on page 38

Pictorial diagram illustrating a switching arrangement which may be used to switch an input transformer in or out of a phono-preamp grid circuit.



Mobile



Ampex

TAPE recorders and automobiles have gone together for quite some time, thanks to an ingenious little device called an inverter, which transforms 6- or 12-volt DC current from automobile batteries into 115-volt AC. But never before have we come across a tape recorder actually *built into* the dashboard of a car. Perhaps this is because few dashboards are commodious enough to accommodate a tape-transport mechanism, but whatever the reason, Radio Monte Carlo in Monaco has transformed the unlikely into a very practical commercial eventuality.

An Ampex 601 transport mechanism has been flush-mounted in the dash panel of a French Citroën DS-19. Preamp controls are located beside the transport where they are easily accessible to the driver. The original Ampex VU meter, detached from its normal mounting plate, has been placed vertically beside a voltmeter and frequency meter in a custom panel where it is instantly visible to the operator from any position.

Some license was taken with normal Ampex switching circuitry by Radio Monte Carlo engineers who wanted an arrangement which would permit simultaneous recording from two microphones. They achieved this by installing two switchable inputs, a configuration which also will permit the playback signal to be blended with a microphone.

Despite such lavish improvisations, the Radio Monte Carlo motorcar still can function as an automobile, since no rider room has been sacrificed for the installation. Cables, mikes, and related gear are housed in the trunk.

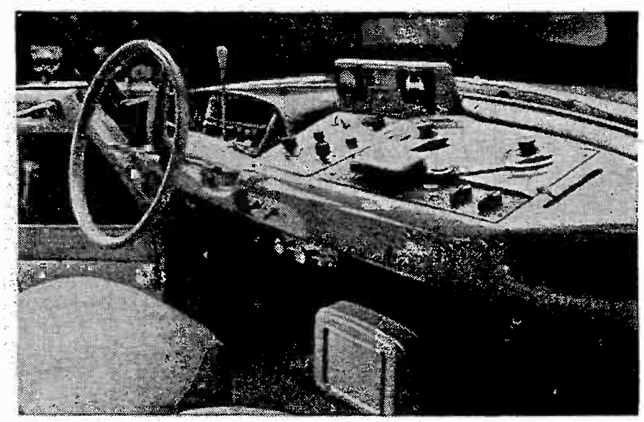
Remote broadcasting — in which microphones are situated to pick up sounds which occur at some distance from the studio — once was a complicated procedure, and not unusually a costly one. Radio stations were forced to maintain trucks which were veritable radio stations on wheels. Even small transmitters were installed which broadcast to receivers usually mounted atop the buildings housing the home stations. The advent of tape recording reduced the problem with regard to both cost and complexity.

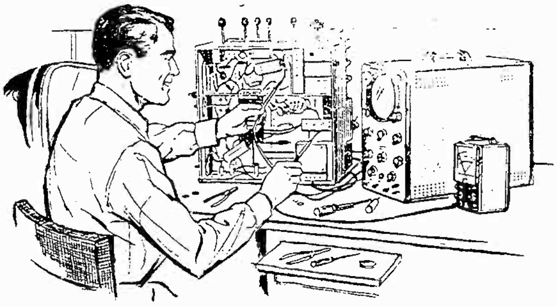
And now Radio Monte Carlo has gone one step further.

Parking-lot view of the Radio Monte Carlo Citroen DS 19. Note the Ampex recorder as seen through right front window.

Photos courtesy *Ampex Playback*

Close-up of Citroen dashboard, showing recorder, switching panel, and housing for volt, frequency, and VU meters.





Using Test Instruments

The Oscilloscope, PART IV (*Conclusion*)

by DONALD CARL HOEFLER

AUDIOPHILES have found the oscilloscope an exceedingly useful tool for keeping their high-fidelity radio systems in top condition, both for trouble shooting and alignment. This month we'll discuss the use of the scope for alignment of both AM and FM tuners. In order to understand the procedure, we should first know how the hi-fi tuner differs from the ordinary commercial set.

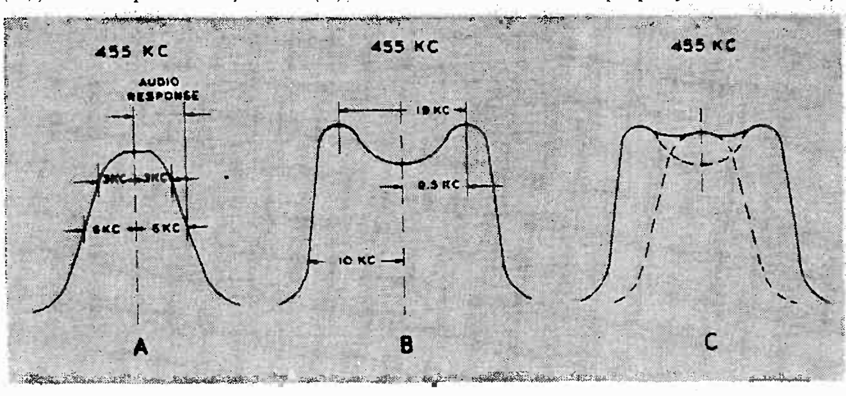
Any modulated radio signal, whether it be AM or FM, consists not only of the station's assigned carrier frequency, but also of a number of *sideband* frequencies on either side of the carrier. An AM station on 710 Kc, for example, with an audio range up to 10,000 cps, is actually transmitting a band of frequencies covering 710 plus-and-minus 10 Kc, or from 700 to 720 Kc. In the case of FM the sidebands are much wider, being as much as 75 Kc above and below the carrier.

Since these sidebands contain all of the audio information, there will be frequency-response distortion in the tuner unless it transmits the entire channel without discrimination. In the average low-grade commercial radio set, using sharply peaked intermediate-frequency (IF) transformers, this sort of frequency discrimination is inevitable. This is shown graphically in Fig. 1A: attenuation begins as little as 2,000 cps each side of the carrier, and at 6 Kc away from the center frequency the response is down by about one-half. It follows that the audio response must be down at least 6 db at 6 Kc.

When a transformer is overcoupled, on the other hand, the characteristic double-humped curve of Fig. 1B is obtained. This would provide a much wider passband, in this case about 19 Kc, with a rather sharp cutoff at 10 Kc either side of center. Such a cutoff is desirable for avoiding interference from AM stations on nearby channels, but the dip in the center of the curve would result in poor low-frequency response.

The tuner shown in Fig. 2 uniquely combines these two characteristics: the input IF transformer *Q* is coupled as in Fig. 1B, while the output IF transformer *R* is sharply peaked as in Fig. 1A. The resultant of these two curves is seen in Fig. 1C, with a reasonably flat response up to about 9.5 Kc either side of the center frequency, and with a sharp cutoff around 10 Kc.

Fig. 1. Appearance of wave shapes on oscilloscope with sharply peaked IF transformer (A); overcoupled transformer (B); and both curves when properly combined (C).



In order to see such a wave shape on an oscilloscope, we need the entire band of frequencies, instead of just one at a time as we have discussed heretofore. The scope is perfectly capable of showing us such a picture, but we also require a new type of signal generator, one that to the scope and to the eye will appear to generate all the frequencies simultaneously.

This instrument is known as a sweep-frequency generator, and it will be discussed in detail in a future article. Since this instrument is not so common as the ordinary RF signal generator, we will confine ourselves this month to alignment methods employing only an RF generator and a scope. This limitation imposes some restrictions on the operator, but since improvisation is part of the audio hobbyist's stock in trade, we'll see what we can do without some of the refinements.

But first, always remember to TURN THE POWER OFF whenever making or breaking any connections on electronic equipment. We'll mention a number of times disconnecting an instrument from one circuit and connecting it to another. If you always remove power before performing these operations, you'll run no risk of getting an electrical shock which can be highly unpleasant, and sometimes lethal.

A vacuum-tube voltmeter can be used

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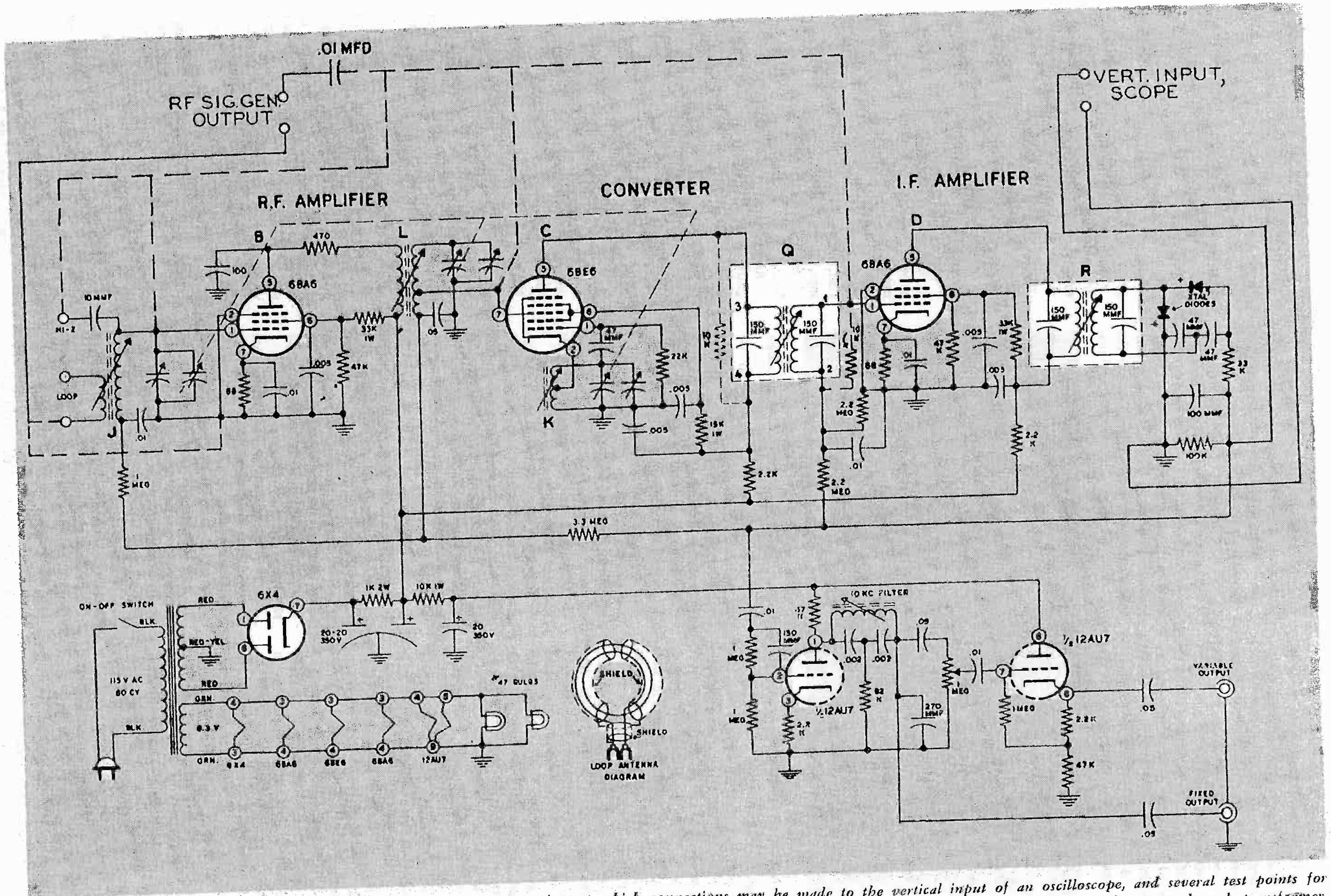

Fig. 2. Schematic diagram of a typical AM radio tuner, showing the points at which connections may be made to the vertical input of an oscilloscope, and several test points for connection to an RF signal generator. The dotted lines from the output of the RF signal generator indicate periodic connections which are made in order to peak each transformer.

Text Continued from page 22

in place of the scope in most of these operations. But since the scope is the more versatile tool, we'll assume its use even when looking only for an indication of voltage maximum.

In AM tuner alignment the scope is connected across the detector output, as shown in Fig. 2, after first being calibrated as a voltmeter with 4 v peak.* Since the alignment operation always proceeds backwards from output toward input, our first concern will be the last IF transformer *R*. The generator is therefore connected to the stage just ahead of it, through a .01-μfd capacitor to the grid of tube *D*. The ground side of the generator cable goes to any convenient point on the chassis.

The generator is set to the intermediate frequency of 455 Kc, with AM modulation on. The scope is adjusted so that 3 cycles of the modulation wave form appear on the screen. Since the internal modulation of most signal generators is 400 cps, the scope sweep is set to around 133 cps.

Now, with all power on for an adequate warm-up period, the secondary of transformer *R* is adjusted for maximum indication on the scope. In this particular tuner, the detector output for most reliable readings should be about 4 v. The generator output should, therefore, be adjusted so that 4 v is indicated when *R* is tuned to maximum.

A screw-driver adjustment on the transformer varies the position of an iron-core slug on this set, while in other cases the inductance may remain constant as small trimmer capacitors across the windings are changed. After the secondary of *R* is peaked, the primary is then tuned in similar fashion.

Since transformer *Q* has a double-peaked response, we will temporarily change its characteristic to look like Fig. 1A by using a 10,000-ohm loading resistor. This is first connected between terminals 1 and 2, while the generator is moved over to the input of tube *C*. The secondary of *Q* is then tuned for maximum, the resistor is moved to the primary side across terminals 3 and 4, and the primary winding similarly peaked.

Alignment of the front end of a receiver or tuner is a little trickier, involving not simply the single intermediate frequency, but all the frequencies in the band or bands to which the set tunes. Furthermore, the tuning indicator should "track," or read fairly accurately at all points on the dial.

It will be noted in Fig. 2 that the oscillator coil *K* and the mixer coil *L* each have three variable devices in their respective circuits. One of them is the main ganged tuning capacitor, which also operates in the RF section ahead of tube *B*. In addition, each has a small trimmer capacitor which is adjusted at the high end of the spectrum, while the core slugs align the low end.

The generator is now connected to the input of tube *B*, and tuned to 1,600 Kc, with modulation. The tuner dial is also set to this frequency, and the trimmer capacitor across *K* adjusted for maximum indication on the scope. Then both the generator and tuner are set at 1,400 Kc, and the trimmer across *L* is adjusted for maximum, while the main tuning dial is rocked slightly back and forth. This rocking is necessary because the maximum output is obtained only when the mixer and oscillator circuits are both properly tuned with a single setting of the main ganged capacitor.

Now the generator and tuner are tuned to the low end of the band, say 600 Kc, and the slug *K* is adjusted for peak output, followed by the slug in coil *L*. It is then a good idea to repeat the entire mixer-oscillator alignment procedure, to correct for any interaction between circuits. Going through the steps several times will do no harm, because each repetition will probably give just a little finer touch-up.

RF alignment is accomplished by connecting the generator to the antenna terminals as shown. With the generator set at 1,400 Kc, tune the main capacitor for maximum. Then peak up the trimmer capacitor across the antenna coil *J*. Set both units to 600 Kc, and, while rocking the tuning dial back and forth, adjust coil *J* slug for maximum. This entire RF alignment procedure can also be repeated several times for a fine touch-up. Then the resistor across *Q* is finally removed, and the set is ready to go.

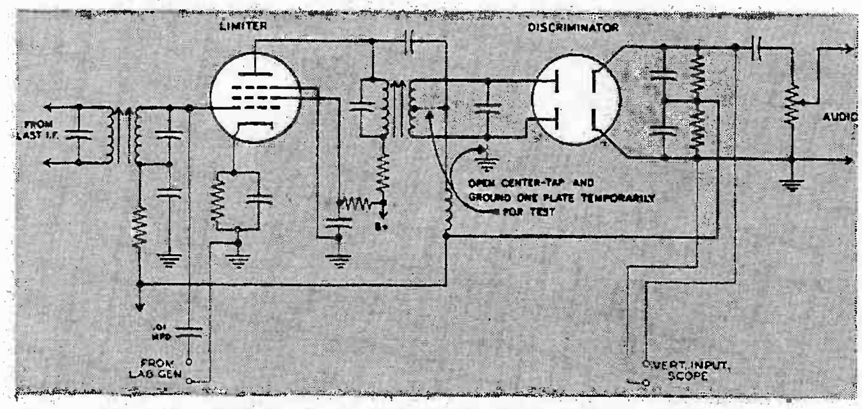

Fig. 4. Alternative method of aligning an FM discriminator by converting it to an AM detector, and adjusting the slugs for maximum output, using an oscilloscope.

Alignment of an FM tuner with ratio detection is basically quite similar to the AM procedure just described. In the circuit shown in Fig. 3, the scope is connected across the output of the ratio detector, and the generator, set to 10.7 Mc, is connected to the input of the first IF amplifier tube *D*. Leaving the secondary of coil *Y* alone for the moment, and beginning with the *Y* primary, the coils *Y* and *X* are peaked. Then with the generator connected to the input of the mixer tube *C*, the mixer-oscillator alignment is similar to that for the AM set. The procedure for the RF section is also basically the same, except that the input signals should be at the extremes of the FM band, perhaps 90 and 106 Mc.

Adjustment of the ratio detector requires that the scope be moved to a position across the volume control. With a constant RF or IF signal being applied by the generator, the secondary coil of *Y* is adjusted for zero voltage indication. The core slug should be moved back and forth a few times to indicate that a voltage appears either side of the correctly tuned position. If this is not the case, tuning has not gone through a null, and the core must be moved farther in or out until a true dip is obtained.

The only truly accurate way of aligning an FM discriminator is by the sweep-generator method to be discussed in a future issue, and the next best is that just described for the ratio detector. But there is another system which will usually give fairly good results, and it requires only an AM generator covering the IF frequency of the tuner, plus a scope or VTVM. This method assumes that both primary and secondary of the discriminator transformer are tuned to the center of the IF frequency, and not stagger-tuned in a bandpass arrangement. Under these conditions the discriminator can be temporarily converted into an AM detector, and the alignment is simply for maximum output.

The circuit modification is accomplished as shown in Fig. 4, with one plate of the tube grounded, and the center tap on the transformer secondary opened up. The local oscillator and automatic volume control should also be disabled, either by grounding or pulling tubes.

Then with the signal generator set to the center of the IF frequency, and

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*Donald Carl Hoefler, "Using Test Instruments," AUDIOCRAFT, II (June 1957), p. 29.

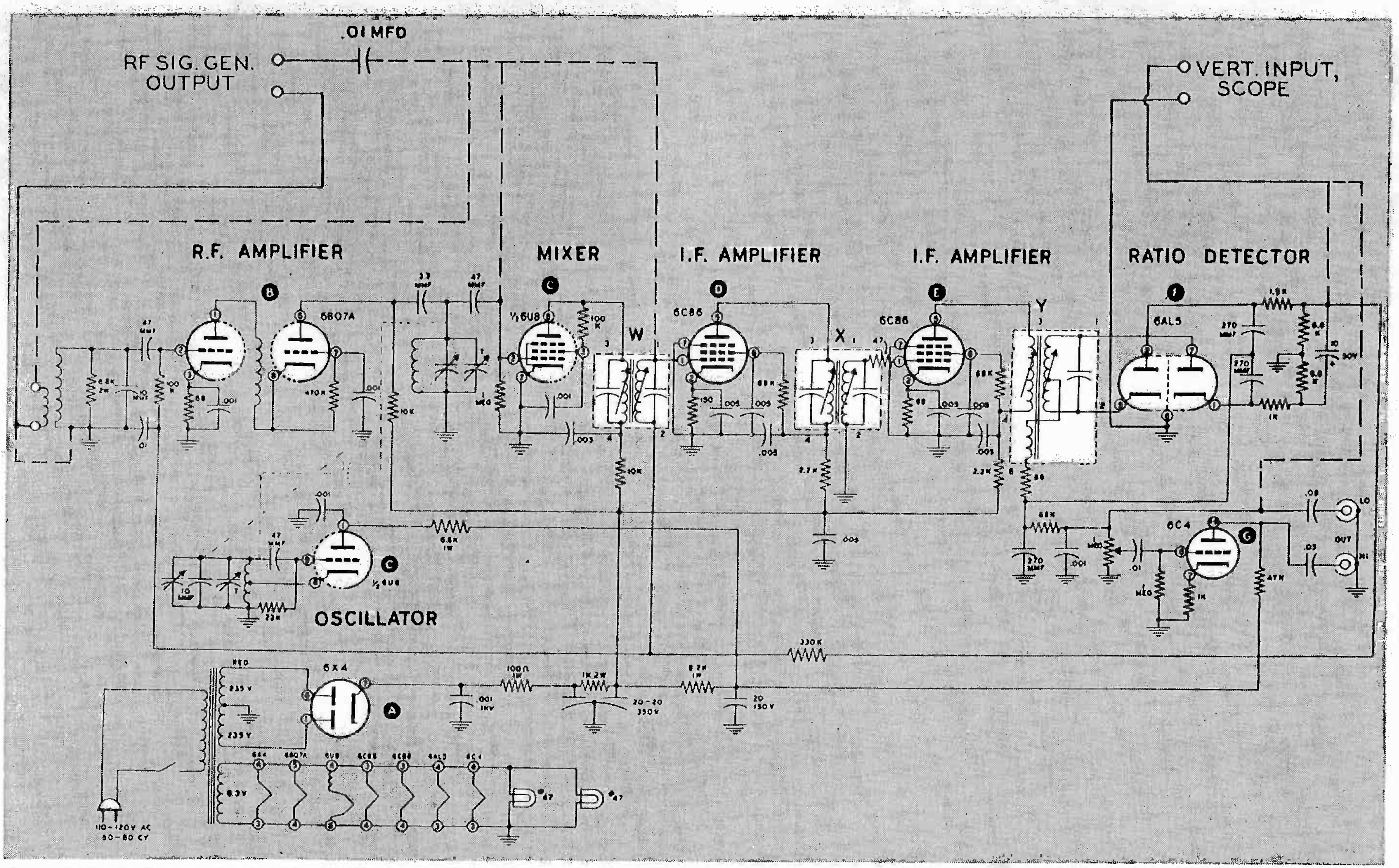
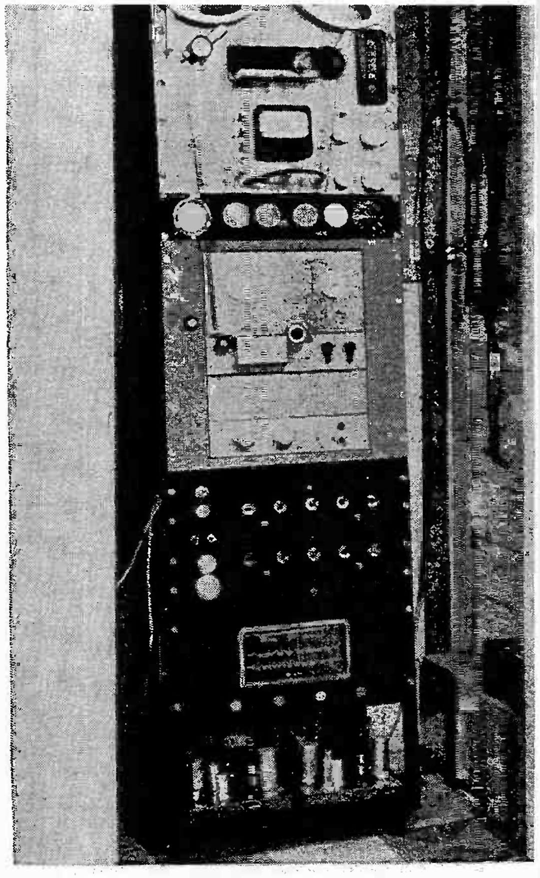


Fig. 3. Schematic diagram of a typical FM radio tuner, showing connecting points for the oscilloscope and RF signal generator. The methods involved in FM tuner alignment are basically the same as those followed to align an AM tuner, but the frequencies differ. The text contains a complete description of the method to be followed in an FM tuner alignment.

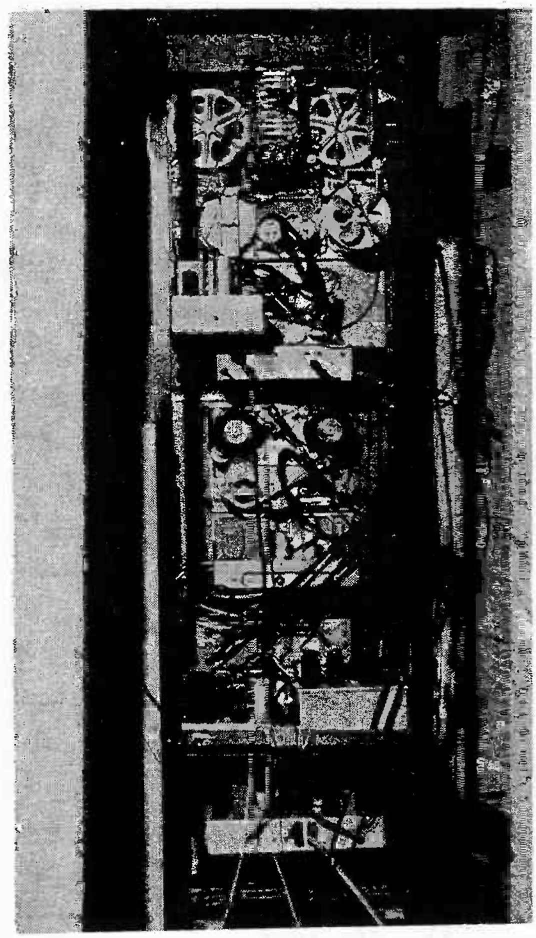
The heart of the system includes, from top to bottom: an Ampex 400 recorder used for monaural recording and playback; McIntosh 20 W-2 preamp for monaural playback; Ampex 612 stereophonic reproducer; Browning AM-FM tuner; and 2 Altec 35 watt amplifiers.



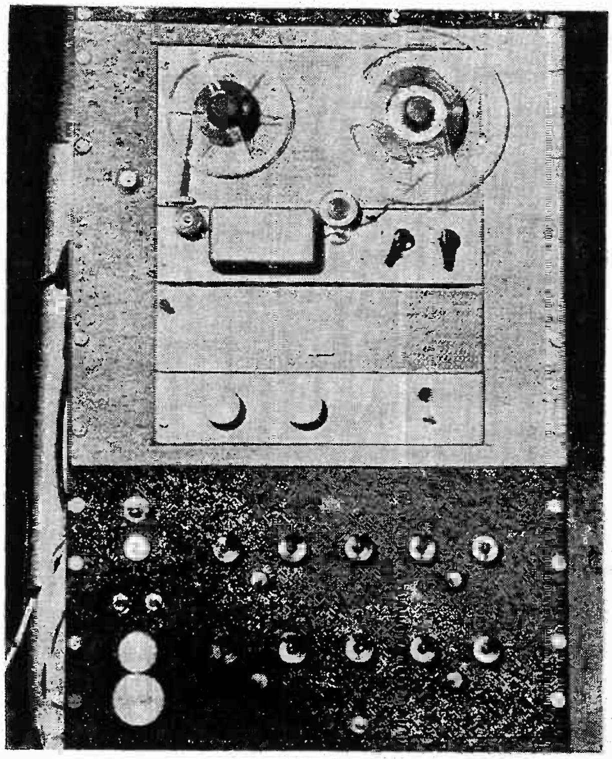
deluxe stereo system

STEREO systems being elaborate per se, herein is described a super-deluxe assembly which overshadows almost any that we know of. Constructed with a preponderance of high-quality components, this rig will do everything but talk, and it requires but a reel of tape to make it do that. Ampex 400 recorder, McIntosh preamp, Ampex 612 stereo player, and Altec amplifiers and speakers produce sound which probably is as low in distortion and wide in range as presently available components can make it. The rig is assembled in the home of Richard H. Cobb, Jr., of Sarasota, Florida, who says that, although the sea and trees in the background aren't essential to perfect reproduction, they do add that final touch to an already luxurious and ear-soothing setting.

Most deluxe audio rigs of any description contain a touch of personal innovation, and Mr. Cobb's system is no exception in this regard. He has built a mu-metal shield around the Browning tuner to isolate it from power supplies located directly above. Mounting of the Ampex 400 on the rack above the 612 reproducer permits tape from the 10½-inch reels to wind over the heads of the 612, for stereo playback of extra-long tapes. And the tape twister which he designed (see illustrations) could well be a boon to any tape recordist who is plagued with occasional warped reels. All in all, this appears to be a rig *par excellence*, and one which Mr. Cobb can exhibit with pride.



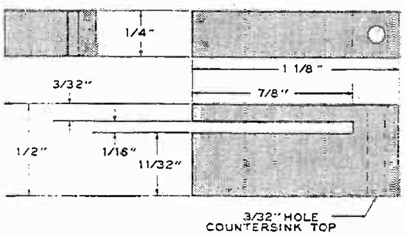
From behind, the equipment rack bares its array of interconnecting cables, power supplies, amplifier chassis, and tape transport intricacies. Placement of power supplies was chosen to reduce hum pickup to a minimum.

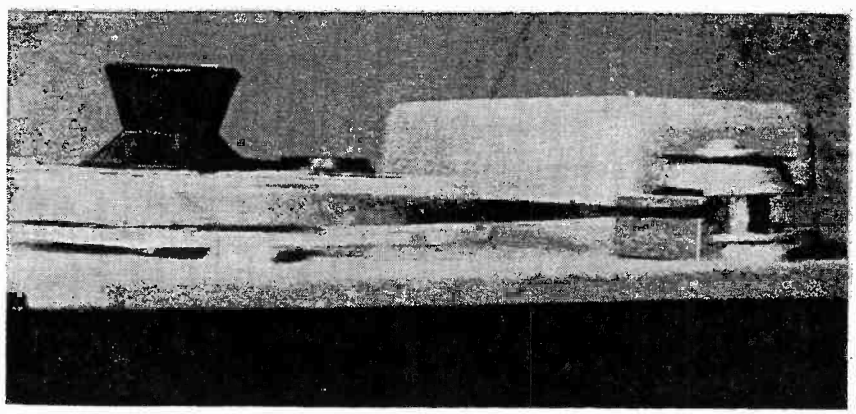


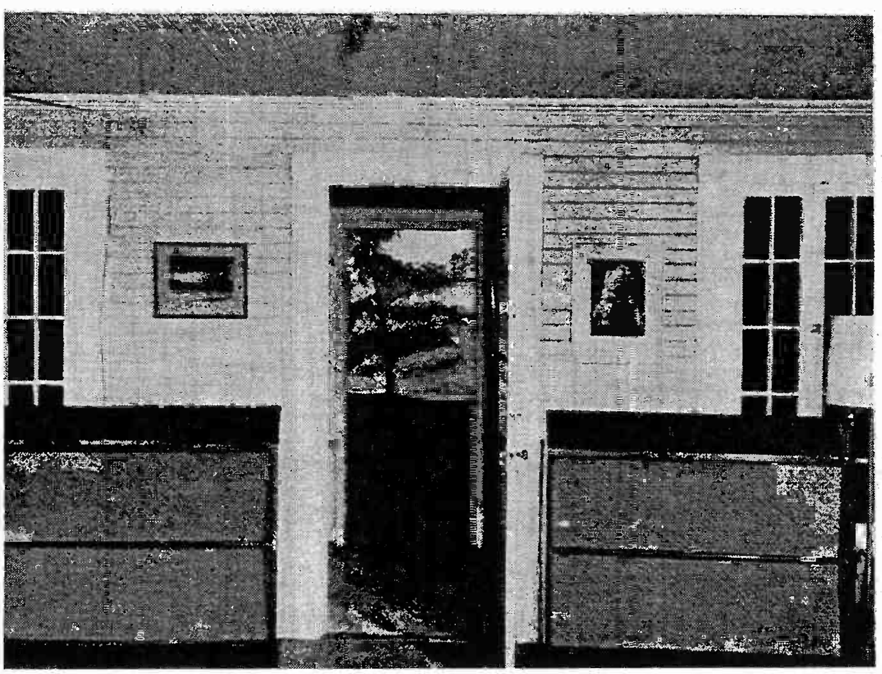
The Ampex 612 stereo reproducer is positioned directly above the switching panel. Switching circuitry is designed so that the stereo signal to the speakers can be reversed — that is, right microphone signal into left speaker — if desired.

This is a close-up of a tape twister designed by Mr. Cobb which quarter-turns the tape as it comes off the supply reel. This keeps tape from rubbing against the sides of a warped reel and causing annoying chatter.

Detail drawing of construction of tape-twisting device shown in photo at right.



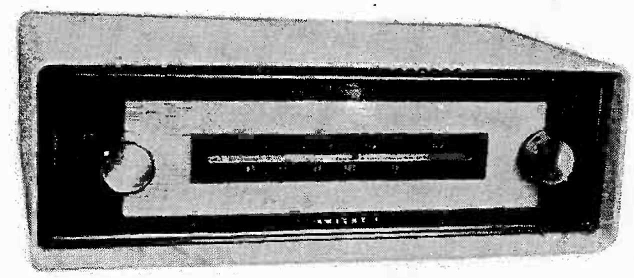




Two Altec 620 speaker systems complete Mr. Cobb's stereo layout. Within the enclosures the speakers are positioned to deliver highs to the inside and lows to the outside, which tends to reduce the bothersome separation effect.

An AUDIOCRAFT *kit report*

by JOSEPH MARSHALL



Knight-Kit FM Tuner

CONSTRUCTION of an FM tuner or receiver at home has been, until recently, a project which only an experienced and courageous technician dared undertake. At the very high frequencies of FM broadcasts, problems of stability, tuning linearity, and adequate sensitivity are acute and critically dependent on dimensional accuracy. Often a fraction of an inch in the length of a lead, or in its placement, can make the difference between excellent performance and very poor or highly unstable performance. The distributed capacitance and inductance represented by wiring and parts placement can throw the tuning off by as much as half the FM band and sometimes shove it completely out of the band. And the equipment and knowledge needed to correct such errors are not to be found in every living room.

We have, therefore, watched the arrival of kits for FM tuners with some misgivings, wondering if the manufacturers were not overestimating the competence of their possible customers — as well as their own ability to turn out a reasonably foolproof kit. Having heard good reports of the $39.95 Knight-Kit FM tuner, we asked Allied Radio Corp. of Chicago, one of whose products is the Knight-Kit line, to send a kit for an AUDIOCRAFT report. To eliminate the suspense, let us say at the beginning that this kit seems to be about as easy to build as any amplifier, preamp, or instrument kit, and is, in fact, less complicated than some. Anyone who can handle a soldering iron with some competence should have no trouble in making this FM tuner, whose performance will compare well with commercial units. Especially gratifying was the discovery that adequate performance could be obtained with only the uncritical alignment procedure described in the manual, which involves peaking the RF trimmer and adjusting the oscillator trimmer at one point on the dial with the signal of an FM station, and without any instruments of any kind.

The secret of this notable achievement lies in the use of a carefully laid out printed-circuit board for the entire signal portion of the tuner. This insures uniformity of distributed inductances and capacitances, eliminates the problems of optimizing wire and lead length, and lead dressage — and, of course, minimizes the need for judgment or skill in assembling and positioning components at VHF.

The circuit of the tuner is given in Fig. 3. It begins with a broad-band untuned cascode RF stage, followed by a 6BA7 mixer with a single tuned coil in between. Half of a 12AT7/ECC81 is used as an oscillator, and the other half

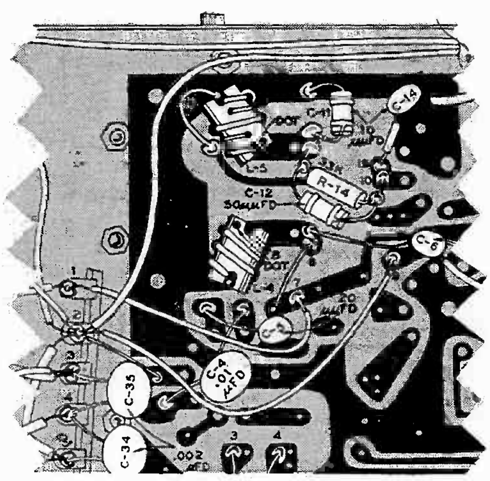


Fig. 1. A portion of the Knight-Kit instruction manual, showing circuit-board parts placement.

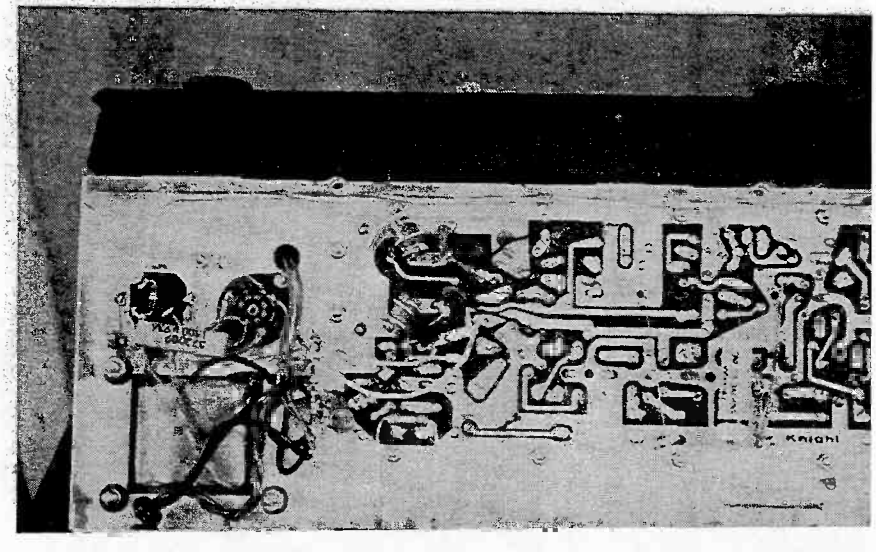


Fig. 2. The underside of the chassis shows the printed-circuit board in place, and connections to the power supply, antenna, and output jacks.

as the automatic-frequency-control tube. The AFC can be disabled by a front-panel switch. There are two IF stages using 6AU6's, followed by a ratio detector which, in turn, feeds half of a 12AU7/ECC82 as an audio amplifier. The output is a cathode follower using the other half of this tube. There are two paralleled output jacks, one for the controlled input of an amplifier or preamp and the other for a tape recorder. The rectifier is a 6X4 whose output is smoothed by a simple but effective RC filter. There is no volume control, a fact that will please some people much less than others. However, if one has no need for the extra output jack, a midget control could be mounted in its place to set the output level.

Construction Notes

Assembly is quite simple and very well described in the instruction manual. The three dozen resistors are supplied and numbered on cards, and the printed-circuit board is printed with corresponding numbers. Step-by-step instructions (Fig. 1) provide a check against possible error in placing the resistors by specifying the value of the resistance as well as the color code for each resistor.

The first step is simply that of inserting the leads of resistors and capacitors into the holes on the printed-circuit board. This can be facilitated if the leads are first bent close to the body and at right angles to it — except for the two or three cases in which the spacing between holes is greater than the length of the resistor. All the components are mounted, and the protruding ends of the leads bent back to hold them temporarily in place, before any soldering is done. We suggest that, as each component is placed in position, a check be made against the circuit-board diagram in the instruction manual, which not only pictures every unit but gives its value as well. Care at this point will reduce the possibility of trouble later. Fortunately, in the few cases where a mistake is most likely to be made by putting one end of a component in the wrong hole, it is almost certain to be discovered when the time comes to place the adjoining component.

Soldering the circuit board is the most critical part of the construction. The foil in this particular board is heavy enough so it is not likely to disintegrate while it is being soldered, but the right kind of iron will greatly facilitate the soldering process. One of the pencil types with a small tip and a 50-watt element is probably the safest; but a gun-type iron with a small tip will work nicely. Be sure the joints are good and that the solder flows well. "Cold joints" will cause all sorts of trouble in performance. Care must be taken not to use too much solder, so as

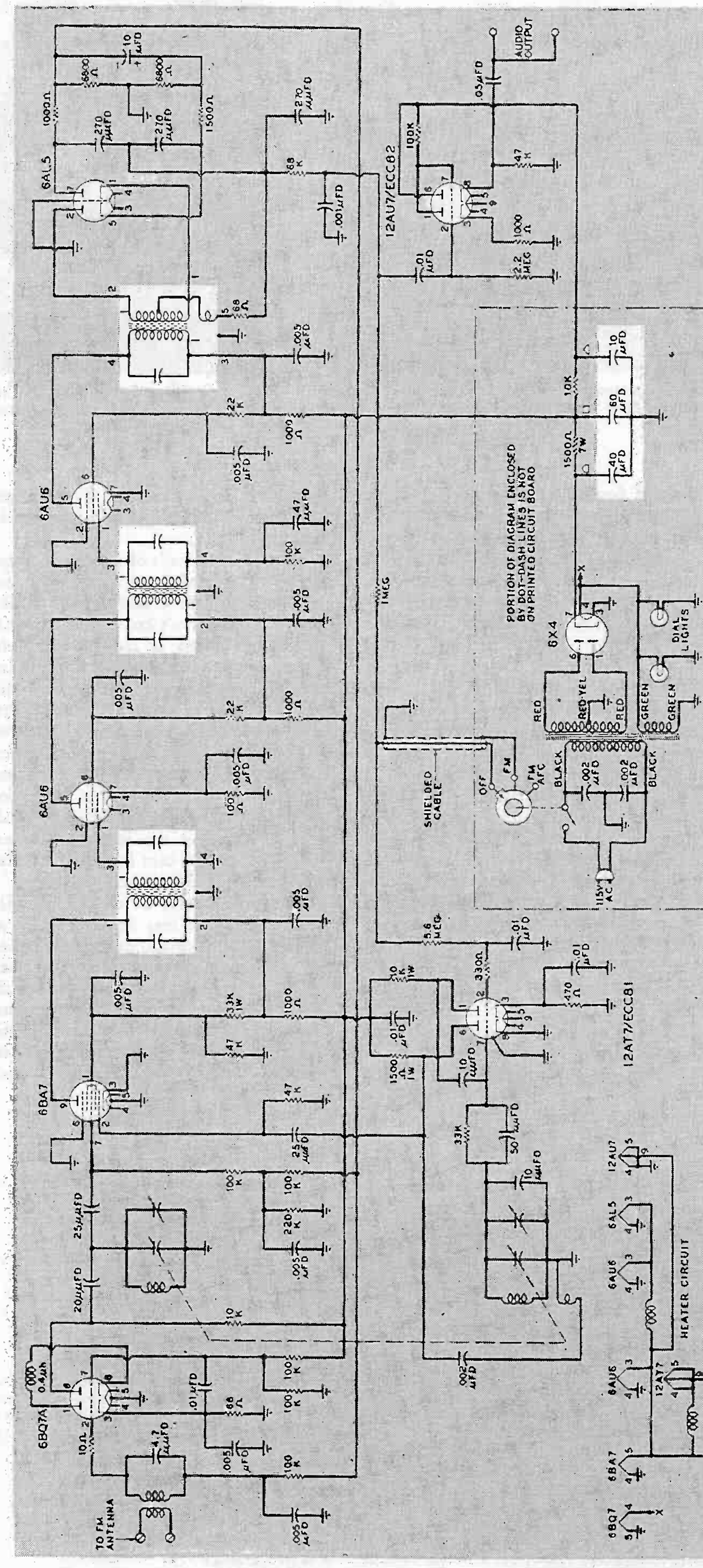


Fig. 3. Schematic diagram of the Knight-Kit FM tuner.

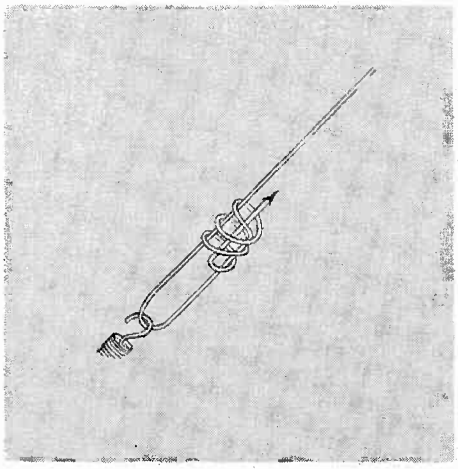


Fig. 4. A nonslip knot for the dial cord. Follow arrow, push knot against spring and pull cord.

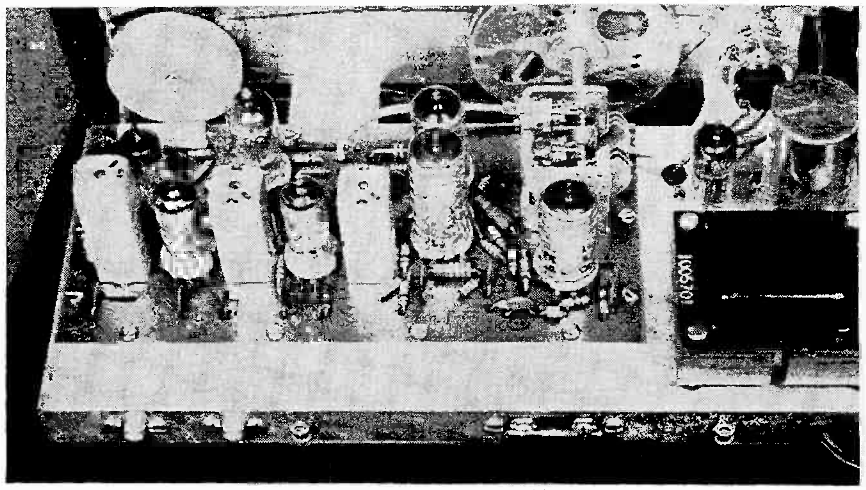


Fig. 5. The top side of the completed tuner shows the uncluttered layout which is possible with printed-circuit boards, which also speed assembly.

to avoid flow of excess solder across the bakelite aisles, which would short-circuit adjacent conductors. Leads can be clipped off as the soldering proceeds to make other leads more accessible (Fig. 6). Incidentally, a pair of diagonal cutting pliers is almost indispensable for a neat job.

After the board is completely assembled and soldered on this side, it is put aside while the power transformer and other components are mounted on the metal chassis. Then the board is mounted on the chassis and the wiring is completed from underneath (Fig. 2). Here, too, there is little possibility of running into trouble. There is a slight ambiguity in the instructions for mounting the RF and oscillator coils, which say, in part, "Push these two leads [of the coil] as far as possible into the holes." The constructor will find, however, that there are little crimps on the leads of the coils which will permit the leads to be inserted just so far and no farther. It occurs to us that some people might decide to straighten out the crimps so the leads can be pushed farther into the holes. Do *not* do this. Those ridges have been made deliberately to establish a limit.

Two or three leads of components that go on the board from underneath are very close to the frame of the tuning capacitor. We don't know if any trouble would be caused if they touched the frame, but we suggest care in placing and clipping them to avoid this possibility. If the soldering is done in big gobs there is also the possibility that one or both of the two metal shields, which go across the printed-circuit board underneath, might ground out a portion of the circuit. The possibility is probably remote, but the instructions warn of it, and double care here will forestall the need for trouble shooting.

Those who have never strung a dial system with cord may find this tricky, although the instructions and diagrams are quite clear (Fig. 7). The most likely source of trouble is that of getting the string too loose. Be sure, therefore, when making the final tie to the spring that the cord is taut enough to extend the spring. Also, be sure you make a good nonslip knot. We find the jam knot diagrammed in Fig. 4 easy and firm. It is borrowed from our trout-fishing experience. Fig. 5 shows the tuner after completion, with all tubes inserted.

AUDIOCRAFT Test Results

We have already pointed out that alignment is not difficult. In areas close to FM stations the peaking process described in the manual will be adequate. But there will be a shift in dial position at the high end when the tuner is inserted into its steel cabinet. Therefore, when setting the oscillator trimmer, adjust it so that the desired station comes in slightly higher on the dial scale than its actual frequency. For peak performance the tuner can be aligned with a VTVM according to further instructions in the manual, or by a technician with the proper instruments and experience. This may make some difference in the weak-signal sensitivity.

The performance of the Knight tuner is excellent; especially gratifying is the low distortion. In this respect it is better

Continued on page 46

Fig. 6. The underside of the printed-circuit board before mounting. Note that a few component leads have been soldered, but not clipped.

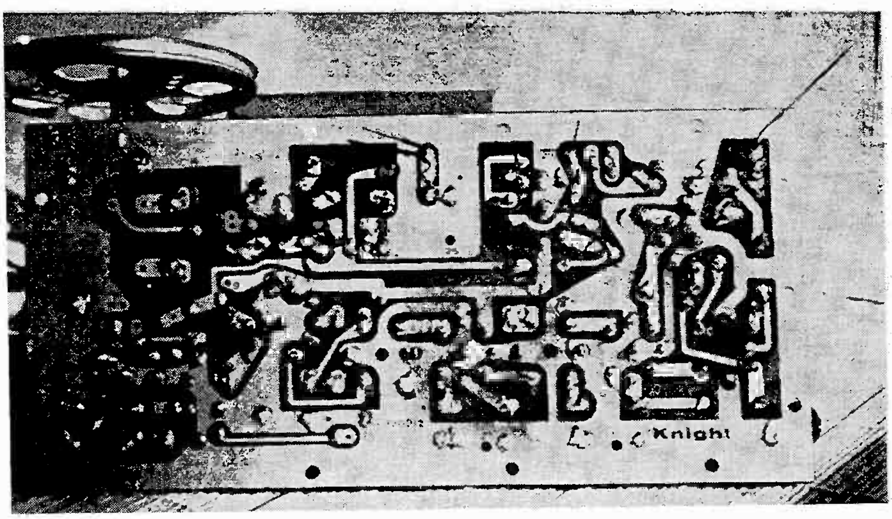
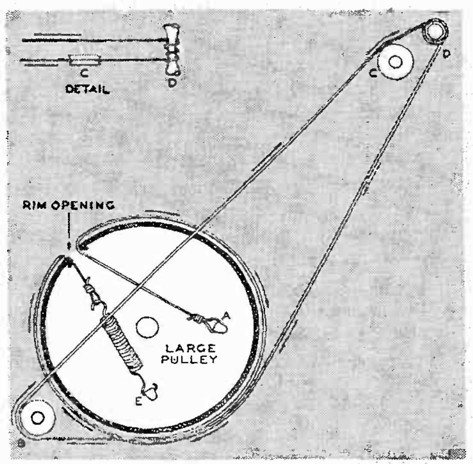


Fig. 7. To install the dial cord, follow the arrows from A, and attach the spring at E.



Calibrate It Yourself

One of the few valid criticisms one can make of kit test equipment is that the calibration is apt to be poor. Any instrument that is a generator (such as an audio signal generator, a voltage calibrator, or a square-wave generator) puts out a wave form, important qualities of which (such as frequency and amplitude) are read from the position of a knob. Since the panels of these instruments are mass produced, they cannot be calibrated to take into account variations in construction, components, and so on.

If it matters to you whether you get 3.5 volts or 4.2 volts output, or whether the frequency is 12 Kc or 13 Kc, don't trust the panel markings. Instead, go to the trouble of marking the panel yourself, putting on it your own calibration points.

Masking tape (or one of the tapes made specifically for writing on) can be applied to the panel and the calibration points accurately marked.

In calibrating, be sure to check against a good standard. To get frequency check points, make Lissajous figures with power-line frequency, or the carrier frequency of a radio station. Check voltage outputs with a good voltmeter, or against a known voltage on an oscilloscope. Even calibrating amplifier or oscilloscope gain controls is often helpful.

The motto of all scientists — mistrust your equipment, especially if you haven't calibrated it yourself — is an equally good motto for audiophiles.

Paul Penfield, Jr.
Cambridge, Mass.

Soldering Aid

"Audio Aids" (February 1957) contained an item on the use of a hemostat as a soldering aid to prevent heat damage to capacitors and resistors. Another simpler gadget to accomplish the same purpose is a modified Mueller No. 60 standard 2-inch alligator clip.

The clip's jaws should be flattened out, duck-bill fashion, for about 3/8 in. at the tips, and filed smooth to provide maximum contact surface. The serrated outside edges can be smoothed off with a file and the instrument is ready for use.

The tool is self-locking. It can easily be inserted in compact assemblies and can be lodged against the chassis for maximum heat conduction. It is especially useful when replacing small components on printed-circuit boards, both as a heat conductor and for strain relief on fragile resistors.

The solder ferrule at the lead end of the clip is handy for storage purposes. Just drive a short finishing nail upright in a convenient place on the workbench or tool rack and set the clip over it.

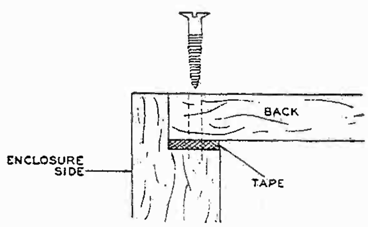
Total cost: 8¢ and 10 minutes' tinkering.

J. A. Bannister
Point Edward, Ont.

Sealing Speaker Enclosures

Most plans for reflex-type speaker enclosures suggest using foam-rubber gaskets between the cabinet itself and the back. This is O.K., but it is sometimes hard to find the foam rubber for the gaskets.

As a substitute, try using ordinary rubber electrical tape (not the new stuff, but the old-fashioned rubber kind) as



Simple way to seal speaker enclosure.

shown here. If the joint has been made with average precision, the rubber tape will be quite satisfactory.

L. E. Johnston
Madison, Wis.

Speaker Mounting Gasket

When one has occasion to remove a speaker from a cabinet, it's often found that the unit will not pull loose from the wood surface after the mounting screws or bolts have been removed. This is because the paper or cardboard ring which holds the cone in place (and forms a slightly compressible mounting cushion) has become cemented to the wood finish through overlong association. This happened to me with a shellac finish inside the cabinet, but it can occur as easily with varnished, painted, or unfinished wood.

I put up with this nuisance for some time, losing some of the cardboard from each speaker as it was pried loose. Then I decided that audio fans, including myself, would be wiser to take precautionary measures to prevent this unpleasantness. In brief, before mounting a speaker on any surface, cut out and lay under it several rings of wax paper, parchment, metal foil, or any similar. nonporous, flat material. This gasket will facilitate removal of the speaker from the cabinet, should that ever be necessary in the future.

Harry L. Wynn
Derry, Pa.

Marking Wiring Diagrams

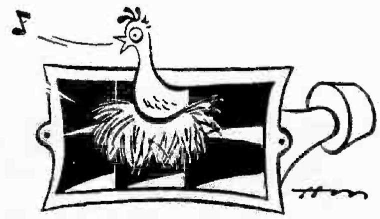
In the Audio Aids column for February of this year, Mr. Paul Penfield, Jr., submitted an idea about marking wiring diagrams in order to avoid miswiring. This is a good idea, but I think it can be improved upon.

Take the schematic and fasten over it a sheet of clear cellophane of about the same size. If the diagram is 8½ in. by 11 in. or smaller, an ordinary clip board can be used to grip both the schematic and the cellophane. For larger wiring diagrams, a piece of plywood of the same dimensions or somewhat larger gives backing, and masking tape will hold schematic and cellophane in place. The cellophane used should be heavier than ordinary wrapping cellophane: thick enough to lie flat without wrinkling, but thin enough to be pliable.

Marking is done with a "china marker" pencil on the cellophane over the wiring indicated beneath.

Advantages of this system are that the diagram itself does not get marked and become hard to read, corrections and erasures are easily made with a cloth, and the cellophane can be reused many times.

David H. Marsh
Arlington, Va.



Sound-Fancier

THE steady flow of correspondents' inquiries for lists of technically outstanding demonstration recordings and the "best" choices for a beginning stereo-tape library puzzled me for a time, until it dawned on me that, although I have been making such recommendations in almost every SFG column published so far, many readers have come in late, or sporadically, and in any case cannot fairly be expected to remember everything published in this column since its debut in the July 1956 issue of AUDIOCRAFT. Occasional reviews or summaries obviously are useful and moreover have the special advantage of embodying the reviewer's reconsidered evaluations. After all, the best proof test of any outstanding recording is not only its ability to impress on a first hearing, but also the effectiveness with which it stands up to further playings.

And, since the fall hi-fi show and audio fair is one when both new converts and veteran sonic *aficionados* are particularly concerned with technical characteristics, both in seeking prime examples of the latest recording triumphs and the severest tests of the exploitable frequency and power ranges of new-model reproducing equipments, the present month is an ideal one for summarizing the past year or two's most notable achievements. One of the accompanying lists is devoted to LP's exclusively (although a few works are also available in single-channel tape form); while I certainly don't pretend that it contains only unanimously accepted "bests," it does represent the time-tested winnowing of my own demonstration and display favorites. The other list, devoted to stereo tapes, it only incidentally representative of sensationally effective recording (although it does contain some of the finest examples of all), since for this list the primary criterion was all-round musical-plus-technical attractions—as befits the selections which I can most unhesitatingly recommend for the basic nucleus of a stereo-tape collection. Of course, neither list can be claimed to exhaust the likely possibilities. There are many other works which I should have liked to include (and probably some others equally worthy with which I am not yet familiar). But at least I can fairly claim that each selection I have included represents the nearest approach I can make to a sure-fire choice.

Potential Further Candidates

It is only because there has not yet been opportunity for sustained repetitive "time testing" that I have not added several brand-new releases to my favorite

SFG-Recommended Demonstration LP's

(Excluding earlier releases listed in the "Show-Off" Records Chapter of *Building Your Record Library*, Roy H. Hoopes, ed., New York, 1956.) Note: An asterisk following the order number indicates that a single-channel tape version is also available. The date in parentheses refers to the issue of AUDIOCRAFT in which an SFG review appeared.

The Regimental Band and the Massed Pipers of the Scots Guards. Rhodes, dir. Angel 35271 (Jul. 56).

Liszt: *Bénédiction* and Sonata. Levy, piano. Unicorn UNLP 1035 (May 57).

British Band Classics. Eastman Symphonic Wind Ensemble; Fennell. Mercury MG 50088 (Aug. 56).

Kodály: *Háry János* Suite. Philharmonic Symphony Orchestra of London; Rodzinski. Westminster W-LAB 7034* (Oct. 56, Aug. 57).

Panorama of Musique Concrète. London/Ducretet-Thompson DTL 930-90 (Apr. 57).

Tchaikovsky: *1812* Overture. Minneapolis Symphony; Dorati. Mercury MG 50054 (Nov. 56).

Spotlight on Percussion. Goldberg and Clarke. Vox DL 180* (Jul. 56).

Bell, Drum and Cymbal. Saul Goodman. Angel 35269 (Sept. 1956).

Fiesta en España. Salicru and Molero. Audio Fidelity AFLP 1819 (Sept. 57).

Arranged for You. Dean Kincaide. Weathers W-5610 (Sept. 1957).

Check & Double Check. Westminster TRC (Sept. 56).

Adventures in Cacophony. Audiophile AP 37 (Mar. 57).

The Compleat in Fidelytie. Cook 1044 (Nov. 56).

Guide

by R. D. DARRELL

technically outstanding LP's. Wöldike's Haydn *Military* and *Clock* Symphonies (Vanguard VRS 492) are a sure bet in their matchless combination of musical and technical perfection. While I shall probably rehear them most often in their stereo versions (VRT 3002-3), the LP's lack only the enhanced spaciousness of an airy acoustical framework which is to be achieved in the new medium; otherwise, the disc versions are a sheer joy to one's ears — as well as to one's mind and heart. The *Military* Symphony is particularly interesting in its unexag-

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SFG-Recommended "First" Stereo-Tape Choices

Tchaikovsky: *Nutcracker* Ballet. Philharmonic Symphony Orchestra of London; Rodzinski. Sonotape SWB 9003-4 (or, abridged, SWB 9002).

The Orchestra. Special Orchestra; Stokowski. Capitol ZH 8.

Rachmaninoff: Second Piano Concerto. Entremont/Goehr. Concert Hall CHT BN 19.

Debussy: Nocturnes. Boston Symphony; Monteux. RCA Victor CCS 12.

Haydn: *Military* Symphony. Volksoper Orchestra; Wöldike. Vanguard VRT 3002.

Handel: *Water Music.* Frankfurt Opera Orchestra; Bamberger. Concert Hall CHT BN 14.

Handel: *Messiah* — Excerpts. Handel & Haydn Society Chorus & Zimbler Sinfonietta; Stone. Boston BC 7-9 (via Livingston).

Saint-Saëns: *Organ* Symphony. Vienna Philharmonic Symphony Orchestra; Swarowsky. Urania UST 1201.

Prokofiev: *Romeo and Juliet.* NBC Symphony; Stokowski. RCA Victor DCS 18.

Mendelssohn: *Italian* Symphony. Pro-Musica Symphony; Van Remoortel. Phonotapes-Sonore S 705.

Antheil: *Ballet mécanique.* Los Angeles Ensemble; Craft. Omegatape ST 6009.

Offenbach: *Gaité Parisienne.* Boston Pops Orchestra; Fiedler. RCA Victor ECS 15.

Stereo Alignment. Sonotape SWB AL 101.

ELECTRONIC ORGAN

Continued from page 17

Thérémin. It is a monophonic or pure-melody instrument on which not more than one note can be played at a time. The pitch of the instrument is varied by movements of the player's hand about an upright antenna. The capacitance of one of two superaudio-frequency oscillators is varied by the changes in proximity of the player's hand to the antenna, and the resulting tone is the beat frequency between the outputs of the two superaudio-frequency oscillators.

The principle of operation of the *Ondes musicales* or *Ondes Martenot,* built in 1928 by the French composer Maurice Martenot, is similar to that of the Thérémin. In this case, however, the capacitance of the variable oscillator is controlled by a cord, one end of which is fastened to a ring on the player's finger. The instrument is provided with a kind of manual to indicate the proper placement of the player's hand for a given note. A key makes it possible to avoid glissando between notes by cutting off the electric current. The *Ondes musicales* can either be played through an ordinary loudspeaker or through a special *diffuseur-resonateur* (Fig. 4), a transducer with taut strings stretched across its face. These strings are tuned to various frequencies.

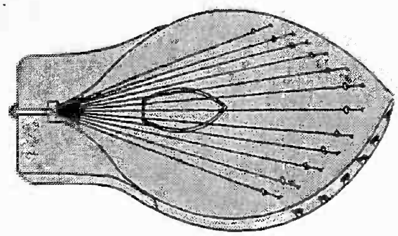


Fig. 4. Sound transducer for the Ondes musicales. *Strings across face vibrate sympathetically with instrument's tone.*

Several other instruments are related to the *Ondes musicales* in principle. The Hellertion, constructed by Helberger and Lertes of Leipzig in 1930, and the Trautonium, built the same year by Trautwein of Berlin, are close relatives. In 1931, the United States produced the Emicon, the first instrument of the type having a true keyboard with a separate key for each note. All of these instruments are monophonic.

The Givelet-Coupleux organ, constructed in Paris in 1930, is an instrument suited to the production of chords and polyphony. One of the characteristic features of the Givelet-Coupleux organ is the use of one complete oscillator circuit for each note. The original instrument was provided with two manuals and pedal, with 23 speaking stops.

One of the most widely known "electronic" instruments, the Hammond organ, was invented in 1934 by Laurens Hammond in Chicago. The Hammond is not, strictly speaking, an electronic instrument at all. Its tones are generated by electromagnetic induction. In the interest of simplicity, the Hammond organ and others operating on similar principles are generally referred to as electronic organs.[2]

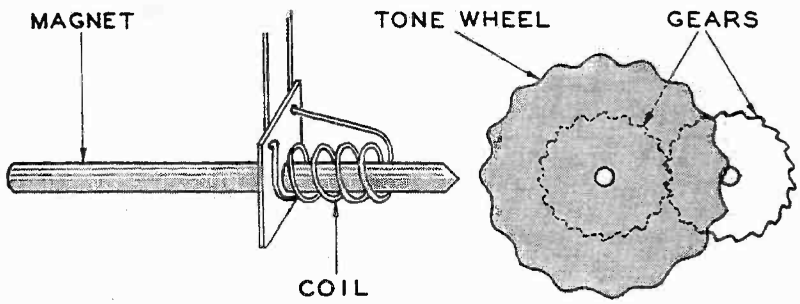
The tone-generating system of the Hammond organ (Fig. 5) consists of 91 rotating steel discs. The periphery of each disc is contoured so that, as it rotates close to a magnetized steel bar, the steel rim of the wheel is effectively brought closer to the magnet and then taken further away. As this process occurs, the change in the magnetic field induces a small voltage in the coil of the magnet. The wave form of the voltage is approximately sinusoidal, and the frequency varies in accordance with the number of high spots on the rim of the disc.

Present-Day Instruments

During the late 1930's and early 40's, development of electronic-organ mechanisms proceeded more rapidly. The fruits of this work, coupled with progress made in the field of electronics in general, made possible the less bulky, more nearly perfect instruments that came on the market after World War II. Today, in the United States, there are perhaps seven or eight different makes of electronic organs generally available, with most manufacturers producing several models. These present-day instruments differ from one another in varying degrees, but the main differ-

[2]The Hammond Organ Company, however, does not apply the term *electronic* to its instruments.

Fig. 5. Simplified drawing of the tone wheel devised by Laurens Hammond in 1934. The Hammond organ is an electromechanical rather than an electronic instrument.



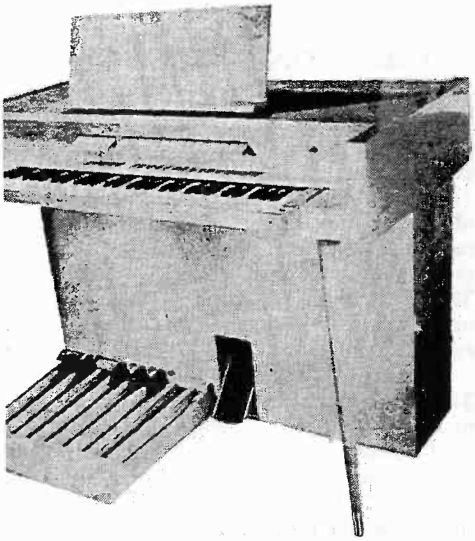


Fig. 6. The Artisan Spinet is a modern electronic organ that can be built from a kit. Complete details about construction of this instrument will be given in later installments of this article.

ence lies in their methods of tone generation. Modern tone generators are refinements of the earlier types mentioned above and, like them, may be classified as being either electromechanical or electronic.

Representative of the electromechanical instrument is today's Hammond organ with its rotating-disc tone-generating system. The Wurlitzer, another electromechanical instrument, uses a different method of tone generation. Its generators are brass reeds which are set vibrating by wind from a fan. The reeds, in conjunction with metal studs mounted above them, act as variable capacitors. The changes in capacitance correspond with the motion of the reeds, so the amplified voltages are replicas of the reed vibrations.

A photoelectric tone generator is employed in a new organ, the Kimball, just introduced this past summer. I learned of the introduction of this instrument only a short time ago and have been unable to get detailed information about it.

Modern electronic tone generators have developed along several different lines. Electronic organs which most successfully imitate true pipe-organ tone use an independent oscillator for each note of the scale. Through the use of independent oscillators, any combination of notes can be played simultaneously, making it possible to employ a large number of couplers and increasing the instrument's tonal potentialities. The cost of this system is understandably great because of the large number of high-quality circuit elements involved. Some commercial instruments utilizing independent oscillators are the Allen, Artisan (Fig. 6), and Conn organs.

Another system of tone generation popular today uses frequency division as

Continued on next page

ELECTRONIC ORGAN

Continued from preceding page

its basis. By this method, the pitches for the top octave of notes are generated by 12 tuned oscillators; all other pitches are obtained by frequency division. The system is simple and inexpensive, but it cannot produce good ensemble tones. The Baldwin, Minshall, and Lowery are organs employing this type of tone generator.

The shared oscillator, used in the Thomas organ, provides a third method of tone generation by which one oscillator is used to produce more than one note, although not, of course, at the same time. This system greatly reduces the cost of the instrument in which it is employed; its disadvantage is that adjacent or nearly adjacent notes cannot be played simultaneously.

The transistor, too, has found its way into the electronic organ. There is now an instrument manufactured by the Gulbransen Company of Melrose Park, Illinois, that uses transistor oscillators. Unfortunately, I have no additional information about it, but it appears, certainly, that a transistorized instrument could have many advantages over one employing vacuum tubes.

Although the electronic musical instrument is still technically in its infancy, even its severest critics will admit that it has made a place for itself in today's musical world. Its possibilities for further development in the future are practically unlimited.

So much for electronic instruments in general. Next month we'll get down to cases with an examination of the Artisan Spinet in particular. We'll see how it works and find out just how much of a job it is to put a small electronic organ together from a kit.

TRANSISTORS

Continued from page 19

them to transistor input stages." Because of the high impedances required, vacuum tubes are much better equipped for this job.

Dynamic mikes: here the advantages of transistors show up. Not only is a costly input transformer eliminated (as compared with vacuum-tube amplifiers), but less noise can be expected.

There are no particular problems in coupling dynamic microphones of 150 or 50 ohms impedance to transistor amplifiers. The simplest circuit (Fig. 6) is perfectly satisfactory. The loss due to mismatch is slight, and the frequency

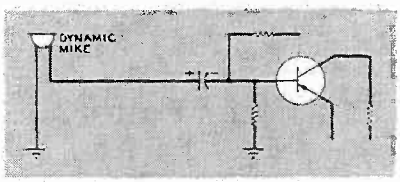


Fig. 6. Simple circuit for coupling a dynamic mike to a transistor amplifier.

discrimination produced by the difference between the nominal impedance and the input impedance is small.

The same ease of coupling is obtained with other low-impedance microphones. For example, in intercom systems a small loudspeaker is usually employed as the microphone. The input transformer ordinarily used can be eliminated by resorting to the circuit in Fig. 6, replacing the dynamic mike by the new transducer.

Ribbon microphones work with the same input circuit.

Similarly, a pair of magnetic earphones can be coupled as a microphone with the same type of input circuit, although of course the sound quality will be poor. The many types of magnetic contact microphones can be handled in the same way. But here there is an equalization problem, similar to that for a magnetic phono cartridge.

Carbon mikes: a carbon microphone has, in effect, a built-in amplifier, so it needs some driving power and puts out a rather high signal. Better over-all results can be achieved with a dynamic mike and one stage of amplification using a transistor: better fidelity, less noise, and less battery drain. However, for those who want to use a carbon mike, Fig. 7 offers one coupling solution.

The single-button mike has for its load a potentiometer which serves as a

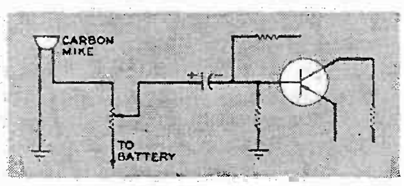


Fig. 7. Possible solution to coupling problem when using a carbon mike.

volume control. The DC biases for the mike and the transistor are different, and are isolated from each other by the capacitor.

Another interesting possibility for a single-button mike is to bias it with the

Continued on next page

TRANSISTORS

Continued from preceding page

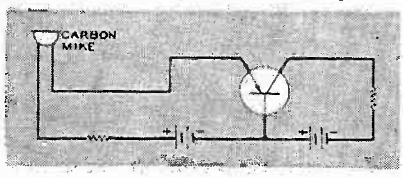
emitter current, using a grounded-base amplifier. Fig. 8 shows the circuit.

It is also possible, because of the large output from the carbon mike, to use the same sort of circuit with a power transistor, feeding the base circuit directly. Double-button mikes can be used this way to drive push-pull power stages.

Condenser mikes: the best advice on condenser microphones, as for crystal microphones, is not to use transistor input stages. The problems with a condenser mike are even more difficult. For reasonable low-frequency response, the microphone must work into a resistance upward of 10 megohms — well nigh impossible with present transistors. If a high enough series resistor is put in the circuit, the noise problem will be severe, and the frequency response will suffer if this is not done. In short, for good results use a vacuum-tube amplifier here.

Often condenser microphones are supplied with an amplifier which has an output impedance of 50 or 150 ohms, and which can be used with input circuits designed for dynamic microphones. In this case, the same considerations hold as for dynamic microphones; do not hesitate to use transistors to advantage.

Fig. 8. An alternative coupling method for use with a single-button microphone.



SWITCHING SYSTEM

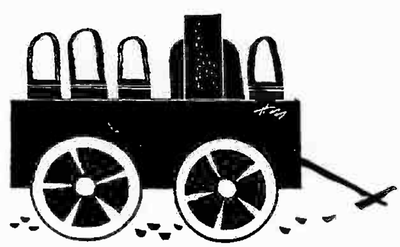
Continued from page 20

put jack on my control amplifier was already insulated from the rear panel, as is the case in many such units. The manufacturer minimizes hum by finding a more suitable ground point, usually close to the first stage of the preamplifier. In the drawing the ground point is labeled A. The original ground connection between the phono input jack and point A was removed and routed to the ground terminal of the new phono jack designated for connection to the input of the ESL transformer. This terminal was then connected to point A. Had the original ground connection been retained as well, a very pronounced ground loop would have been formed.

As the illustration shows, both windings of the ESL transformer are grounded inside the box on which the transformer is mounted. To prevent a ground loop, it is therefore important not to make a connection between the ground terminals of the jacks to which the transformer is connected.

Since the ESL transformer has a phono jack at the input, it is necessary to make up a shielded cable with a phono plug at each end to connect this input to the proper control amplifier jack (upper jack, center, in the drawing on page 20). Output of the transformer is carried by a shielded cable with a phono plug already attached, which can be inserted into the appropriate control amplifier jack (lower jack, center). Transformers for other low-level cartridges have different connections, but the input and output circuits should be treated in the same way.

It can readily be seen that, when the switch is thrown to the right, the signal from the phono cartridge is fed by the upper part of the switch to the input of the transformer; and the amplified signal from the transformer is fed by the lower



arm to the grid of the phono preamplifier tube. When the switch is thrown to the left, the signal from the cartridge goes directly to the tube grid.

As a final note, it should be pointed out that readers using the ESL 301F transformer should provide a load resistor of 1.5 K in order to obtain relatively flat bass response. Although as much as 6 db more output can be obtained by working into higher loads, this advantage is purchased at the cost of reduced response in the region of 50 cps. You can easily mount the 1.5-K load resistor, as I did, in the box that supports the transformer. This permits the required load resistor for the cartridge used with 78 records to be mounted at the grid of the phono preamplifier tube. The latter resistor is ordinarily of much higher value, usually in the range of 27 K to 100 K, and therefore does not significantly affect the load upon the secondary of the ESL transformer. Another alternative is to solder the load resistor for the 78 cartridge directly across the terminals of this cartridge. Such soldering should be done quickly with a very small soldering iron to avoid possible damage to the cartridge; a pliers should be held to the work as a heat shunt.

TEST INSTRUMENTS

Continued from page 24

the modulation on, it is connected to the input of the last IF or limiter amplifier. The scope is connected directly across the discriminator load, and the transformer secondary and primary are adjusted for maximum, repeated a couple of times. When the alignment is completed, the receiver is put back into service by restoring the discriminator, oscillator and AVC circuits to normal.

When working on high-impedance or high-frequency circuits, it is often neces-

Courtesy Heath Company

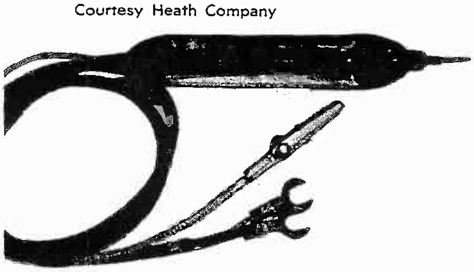


Fig. 5. *The Heathkit demodulator probe.*

sary to observe the precaution of using some isolation in the form of a resistor or capacitor in the scope input lead. While a shielded lead is often necessary to avoid stray pickup, it has the disadvantage of adding considerable capacitance across the circuit under observation.

If the input resistance or capacitance

Continued on next page

TEST INSTRUMENTS

Continued from preceding page

of the scope circuit has a tendency to act as a shunt to the circuit being tested, detuning may result, and false indications will be given by the test instruments. The best way around these problems, as well as a means of increasing the over-all usefulness of the scope, is through the use of a demodulator probe.

With its own demodulator, the scope can go anywhere, not being limited to working at a point following the detector in a set. It will show the modulation envelopes and over-all bandpass characteristics at any point in the RF or IF circuits, and can also be used as a signal tracer or gain analyzer.

The detector in a typical demodulator probe is a crystal diode, mounted on an etched circuit board for minimum ca-

pacitance. All components are shielded by a metal probe housing, which is grounded to prevent hand capacitance effects from causing deflection of the scope trace. A photo of such a probe is shown in Fig. 5.

Next in this series will be a discussion of RF generators, and their applications in hi-fi audio work.

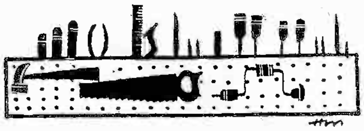
GROUNDED EAR

Continued from page 5

Williamson-type amplifiers to new front-end circuitry. I have just learned that the Dyna Company, 617 North 41st Street Philadelphia 4, will supply, for $10, a preassembled printed-circuit board which contains all the components for the front end of the Dynakit Mark II and the socket for the 6AN8 tube. Use of this assembly would greatly simplify such conversion, and also, of course, the building of entirely new amplifiers. Assembly requires cutting a single square hole and making only a few connections to the output tubes and the power supply. This conversion ought to result

The regular feature, "Tape News & Views," does not appear this month because J. Gordon Holt has been on vacation. Mr. Holt's column will be back in AUDIOCRAFT *in November.*

in greater stability, particularly a cleaner low end and freedom from high-frequency ringing. However, it is not an operation which should be undertaken



by the inexperienced. The feedback loop will require readjustments for which no one can give instructions except in the most general terms. But those who have sufficient knowledge to make this and the other readjustments of circuit and parameters which would be required, should find the assembly a great time and money saver.

SOUND FANCIER

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gerated treatment of the Turkish-music episodes for percussion: at first hearing, less sensational than in the famous Scherchen-Westminster versions, but on consideration, obviously better proportioned to the work as a whole as well as more authentically close to what one hears in a live concert-hall performance, where the percussion is not spotlighted in front of the rest of the orchestra, but is heard — with no loss of crispness or brilliance — well in back of the other choirs.

I was especially anxious to hear the *Hi-Fi Fiedler* (RCA Victor LM 2100) program of Rimsky's *Coq d'Or* Suite, Rossini's *William Tell* Overture, and Tchaikovsky's *Marche slave*, since I had been informed (when asked to write the liner notes) that the RCA Victor

engineers themselves believed these recordings to represent their finest current standards. From that, I had naturally expected something out of the ordinary (which the engineering here certainly is), but I hadn't been prepared for the rigorous refusal to exploit the obvious possibilities of display sensationalism. The music here of course possesses wider dynamic and coloristic qualities than the Haydn symphonies above, yet for all its blazing brilliance the recording proves primarily impressive for the crystalline *purity* with which it transmits naturally balanced concert-hall sonorities, all the

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SOUND FANCIER

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way from the most powerful climaxes right down to the most delicate pianissimo details. These works, too, are also available in stereo (CCS 40 and BCS 41) and of course are even more wide-canvassed aurally there — yet, like the Haydn symphonies, scarcely more lucid or sonically true to the scores themselves.

Two other superb examples of the present-day ideal in recording — pellucid authenticity to the original sonic blends and contrasts — are the set of four Haydn Piano Sonatas by Ernst Levy on Unicorn UNLP 1036 and the *Music of Bali* by the Pliatan Gamelan Orchestra on Westminster XWN 2209 (two 12-inch). The wondrously bright and "ringing" piano tone in the former is as much of an aural delight as that of Levy's early Kresge Auditorium Liszt and Beethoven recordings; and in some ways this disc is even more impressive for its sense of dramatic power held in reserve rather than fully exploited. Here, too, much to my surprise, Levy's readings strike me as less pretentious and mannered — indeed, ideally suited to Haydn's quirky humor and eloquent songfulness, as well as to his bolder flights of harmonic and archetectonic daring. The Balinese album is also notable for the restraint and tastefulness with which it encompasses the wide range of gamelan dynamics and timbres from the wildest chattering and jangling to the coolest glassy tinkles. Musically it is more varied than most previous Balinese releases and, although some of the pieces may seem interminable to some occidental ears, those of the true sound fancier will be fascinated throughout — and not least by the strange, quite *musique-concrète* effects in the incantatory *Kèchak* for unaccompanied male chorus.

Contrasting Hi-Fi Approaches

It may be easier to appreciate just what is being attempted in these latest refinements (perhaps even more than developments) of high-fidelity techniques if one retraces some of the paths broken earlier. Listen first, for example, to the Camden LP reprint (CAL 352) of Toscanini's Beethoven Seventh Symphony which in its original 1936 78's (RCA Victor M 317) was considered an outstanding recording of its time. Passing over the fact that as a performance it still remains unsurpassed (although in one minority view it seems more vehement than even the inexhaustible vitality of the music demands), it still has its definite excitements — yet for all its strength, how bodiless and "juiceless" tonally it now sounds!

Then hear the *Hi-Fi Feast for Orchestra* (Westminster XWN 18451), which reprints two 1955 display programs by Quadri originally issued on W-LAB 7004 and 7009 (and in part on Sonotape SW 1005 and 1020). Throughout, this is a spectacular demonstration of hi-fi's tremendously expanded frequency and dynamic ranges, but a considerable part of its effectiveness stems from a close-up prominence of percussion, brass, and other spotlighted solo parts, marvelously dramatic and undistorted, but quite unlike what one is ever likely to hear even in the front-row seats of an actual concert hall. Add to this Quadri's interpretative mannerisms and strange tempo choices and one has almost a hi-fi parody of the Dukas *Apprenti sorcier* and Saint-Saëns *Danse macabre*, for examples. Some of the other pieces in this extensive program (notably the Chabrier *Marche joyeuse* and Revueltas *Sensemaya* and *Cuauhnahuac*) come off more successfully. Yet while the crispness of the transients throughout makes this an audiophile's delight, more musically discriminating listeners will realize (today more easily than a couple of years ago)

that such engineering triumphs have been won only at the high cost of a loss in auditorium authenticity and aesthetic equilibrium.

But at least this is fine *sound*, whereas Markevitch's highly publicized first American recording — the Brahms First Symphony with the Symphony of the Air (Decca DL 9907) — pleases me neither sonically nor musically. My finding the reading so torpid and ponderous may be discounted as an idiosyncratic prejudice (although I've vastly admired Markevitch's conducting of other, modern works for which I feel he is

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SOUND FANCIER

Continued from preceding page

temperamentally far better suited), but surely there can be no excuse today for the intolerable bottom heaviness (and badly focussed low-frequency tonal qualities) in what otherwise might be a fine modern recording. Well, the Deutsche Grammophon engineers have done such fine work on their own home grounds (they were perhaps the first to formulate the present ideals in tonal purity) that they certainly can be forgiven the present miscalculation of unfamiliar conditions. Meanwhile, this disc is a valuable reminder that the vast powers at the resource of hi-fi recording can work more harm than good if they are allowed to get out of control or to distract attention from the music and scoring to which they should be wholly subservient.

"Quieter" vs. Bolder Virtues

A matchless example of this subservience of technique to content (here also characteristic of the interpreter no less than of the engineers), as well as what I like to call hi-fi's "quieter" virtues (i.e., its nonsensational transparency and tonal authenticity) is the album of the three Mozart Sonatas and two smaller piano pieces by Landowska (RCA Victor LM 6044). I have sometimes been bold enough in the past to quarrel with the Grande Dame's Bach harpsichord performances on grounds of overvehemence and stylistic mannerisms, but here (despite the fact that she adds ornamentations not actually included in the scores and "arranges" the *Ländlerische Tänze*, K. 606, which have been preserved only in string-trio scoring), everything not only seems well within legitimately Mozartean tradition, but infectiously communicates Mozart's most characteristic

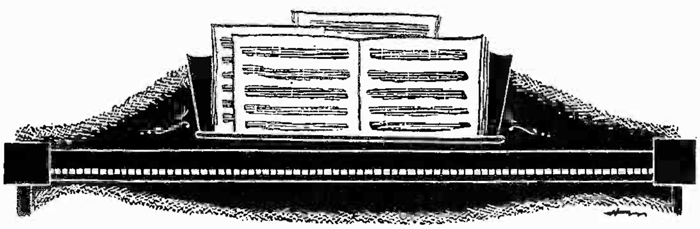
vital blend of lyricism and imagination. The properly small piano tone throughout is reproduced with immaculate cleanness and sparkle.

Nearly as good technically, if not quite as enchanting interpretatively, is the disc of three Mozart Violin Sonantas (K. 301, K. 304, and K. 380) by Wolfgang Schneiderhan and Carl Seemann (Decca DL 9886); and the Bach Sampler from Vanguard (SRV 105, $1.98), which reprints from earlier large-scale albums Prohaska's fine if slightly hurried Second Brandenburg

Concerto, vivacious B-minor Suite, the famous Air from the D-major Suite, and — from a more recent release — Jan Tomasow's fine-spun performance of the E-major Violin Concerto.

But devotees of hi-fi's more extraverted characteristics, and of scintillating sound for its own proud sake, should not despair; there is still plenty of genuinely sensational brilliance available, but now for the most part confined to repertories where its predominance over musical contents is either harmless or desirable. Listen to the *Dukes of Dixieland*, Vol. 3 (Audio Fidelity AFLP 1851) wherein the Unreconstructed Southerners' percussion really sizzles, and their tuba shakes the house foundations in music which calls for exactly such extremes: a batch of uninhibited New Orleans processionals, topped by *When Johnny Reb Comes Marching Home.* Or hear the same company's *Mallet Magic* (AFLP 1825), wherein Harry Breuer demonstrates his virtuosic mastery of marimba, vibraphone, and xylophone in musical trifles or parodies (like the *Bumble Bee Bolero* and *Sambra macabre*, a long way after Ravel and Saint-Saëns respectively). Most of these pieces would be quite pointless except for the zippy razzle-dazzle of their varied percussive sound qualities.

Outside such specialized repertories, however, the future for sheer sonic sensationalism in the single-channel medium now seems severely limited. In my opinion the arena for further refinements and developments has shifted squarely to the stereo medium where *everything* begins to seem possible — even a satisfactory reconciliation of hi fi's quietest and most blatant virtues, with the former enlivened by tonal luminosity and buoyancy, and the latter made more aurally attractive by their wider dispersal in an expanded acoustical ambience. But that, of course, is another chapter in the breath-taking serial saga of current audio progress!



KNIGHT-KIT TUNER

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than many higher-priced, ready-made units, and not greatly inferior to the expensive wide-band tuners. This may be accounted for, perhaps, by the fact that informal alignment without instruments results in a wider than usual IF band width. No trouble was experienced with drift after the initial ten minutes on local stations, although on remote, weak stations it was necessary to retune several times during the first hour after which the AFC was able to hold the signal in tune. Selectivity and adjacent-channel suppression were not remarkable, but judged adequate for all but a few especially troublesome installations. In fact, for use in primary signal areas the tuner left little to be desired.

With careful alignment the weak-signal sensitivity was surprisingly good,

and we are convinced that our sample unit exceeded the specified or claimed sensitivity. The distortion remained low and the noise suppression was good. The tuner is also very handsome in its case. We should say that this unit would be completely satisfactory in the great majority of locations. For a kit costing under $40, that is a high recommendation indeed.

READERS' FORUM

Continued from page 15

boxes have been squared off in an ugly fashion, and the type used in the caption and the feature announcements is unappealing and too large.

I suggest an immediate return to the old cover, although I suppose you must get the magic words, *hi-fi*, in there.

J. Peter Denny
Durham, N.C.

Gentlemen:
About Mr. Eugene I. Cleveland's letter stating that he dislikes your new cover design, I say your correspondent doesn't

PROFESSIONAL DIRECTORY

TRADERS' MARKETPLACE

Here's the place to buy, swap, or sell audio equipment. Rates are only 20¢ a word (excluding name and address) and your advertisement will reach 20,000 to 35,000 readers. Remittance must accompany copy and insertion instructions.

COMPLETED-TESTED HEATHKIT W5M $55.00. Fred Bauer, Jr., P. O. Box 7307, Memphis, Tenn.

STOP GUESSING. Build Impedance Bridge for measuring inductance, capacitance, resistance. Description, circuitry, photos, $3.00 postpaid. Lawrence, 3820 Purdue St., Houston 5, Texas.

UNHAPPY WITH "HI" hi-fi prices? So alright already . . . Write already. Key Electronics Co., 120 Liberty St., New York 6, N. Y. EVergreen 4-6071.

Want a reprint of the FM station list that appeared in AUDIOCRAFT *earlier in the year? The list has been revised and is now available. See the ad on page 48 for complete details.*

know the meanings of the words *cheap*, *gaudy*, or *commercialized*.

I feel that your new cover is an improvement over the previous one. My congratulations to Roy Lindstrom for his good artistic sense.

J. Simard
Quebec, Que.

Gentlemen:

I'm afraid I must agree with Mr. Cleveland's opinion of your new cover. If I didn't already know what was inside the cover, I would have a much lower opinion of the magazine.

I like your index page, but the cover is definitely below the standard set by the design of the rest of the magazine.

Roy J. Irvine
Harlingen, Tex,

Since reader reaction to the new cover design was generally unfavorable, we are trying something a little different. Let's hear what you have to say about this one. — Ed.

Gentlemen:

As a charter subscriber to AUDIOCRAFT, I have been restrained from writing this letter for nearly two years by a huge inertia factor. Now, however, here is your plug. AUDIOCRAFT is a fine magazine; technical enough for a nonelectrical engineer (myself), interesting and informative enough for nontechnical readers (several neophyte friends).

I would like to make one minor criticism. Why can't record reviewing be left to the publications it belongs in; e.g., HIGH FIDELITY, the *Saturday Review*, and so on? I fail to see why technical journals and hobby magazines should spend precious white space doing ineffectually that which is best done by periodicals whose prime business it is.

William Rosenstein
Brooklyn, N.Y.

Our record reviews are intended to do that which is done ineffectually in the standard review publications: that is, to comment specifically and reliably on the technical quality of new disc and tape releases. We hope they have succeeded in doing so. — Ed.

Gentlemen:

On the weekend preceding the IRE convention in New York last spring I attended a Sunday-afternoon concert at

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READERS' FORUM

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Carnegie Hall. After settling down to enjoy the music, a fellow in the row ahead of me turned to his companion and whispered, "Not enough bass, don't you think?"

I thought the remark was rather funny at the time, but the funniest part was the fact that I agreed with him. The Philharmonic sure wasn't putting out the bass the way my speaker system can!

If it is the purpose of high fidelity to reproduce sound accurately and uncolored, one has no choice but to compare the output of the hi-fi system with the original sound. It is all too easy to base the comparison on other hi-fi systems or on a standard arrived at by listening to electronically reproduced music. This will hardly be news to some people, but many strive unconsciously, I think, to match other hi-fi systems or their own preconceived ideas of what music should sound like.

Avoiding the question of whether it is right or wrong to color the sound, such coloration should, at least, be consciously done. Perhaps the advice comes a trifle late; the March *Educational Forum* reported that in 1955 classical-music concerts drew 35,000,000 people — more than twice the number drawn by organized baseball!

Paul Penfield, Jr.
Cambridge, Mass.

Gentlemen:
I have been a reader of your magazine almost since its beginning, but I do not have a copy of the December 1955 issue, which I'd like to obtain to complete my file. Would you put a note in "Readers' Forum" to the effect that I should be willing to pay a good price for a copy of this issue in reasonable condition?

George G. McKinley
P. O. Box 468
Glasgow, Ky.

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