

November 1955

Volume I Number I

audiocraft

THE HOW-TO-DO-IT MAGAZINE OF HOME SOUND REPRODUCTION

Authors for this issue, in order as they appear in the contents list opposite:

Joseph Marshall, indefatigable audio experimenter and prolific contributor to slick as well as technical magazines, lives in Ozone, Tenn. Must be nice country; he rarely leaves except at audio show time.

J. Gordon Holt is our most recent staff acquisition. Formerly of Wallingford, Pa., his avocation is (naturally) recording.

Irving M. (Bud) Fried, proprietor of Lectronics at City Line Center, Philadelphia, has written several articles for HIGH FIDELITY Magazine. He can be fairly described as an audio perfectionist.

George Bowe of Kensington, Conn., is on the staff of WTIC and WTIC-FM, Hartford. Among other chores there he runs a program of hints for the handyman titled, appropriately, *Let George Do It!*

Karl Kramer is Manager of Technical Services for Jensen Manufacturing Company, Chicago, and has a writing style as complete and concise as his title is long.

William C. Bohn, who has written for HIGH FIDELITY also, is another professional. He operates Bohn Music Systems Company, 550 Fifth Avenue, New York City.

John E. Lauer of Boulder, Colo., is an experienced electronics hobbyist and a physicist at the University of Colorado.

R. D. Darrell now lives in Stone Ridge, N. Y., but he has been around in music and audio longer than many of us can remember. He is the author of several books, among them the famous *Gramophone Shop Encyclopedia of Recorded Music*.

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The magnificent McIntosh power amplifier MC-30 sets a new standard of performance. Never before in high fidelity history has distortion so low been *guaranteed* with power so great! (Harmonic distortion, 20-20,000 cycles, $\frac{1}{3}\%$ at 30 watts, $\frac{1}{10}\%$ at 15 watts. IM distortion below $\frac{1}{2}\%$ even at peak 60 watts! Inaudible hum level, 90 db below rated output.) This outstanding performance assures absolute purity of input signal reproduction, and the complete absence of possible added discordant tones. Adequate power reserve captures all the subtle harmonics and overtones present in the original sound.

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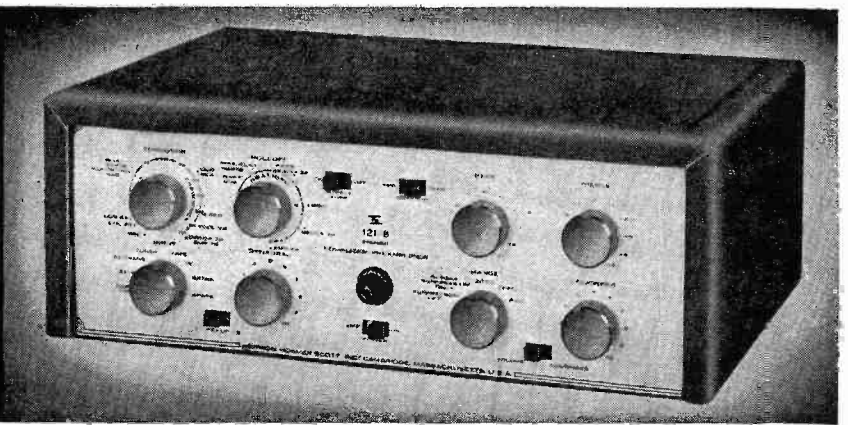
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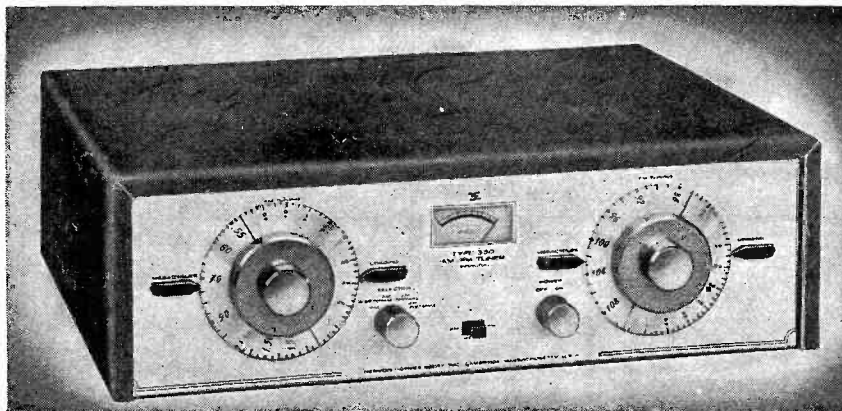
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*Slightly higher west of Rockies.



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New Advance
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ONLY really wide-range AM, plus super-selective FM

- Now you can receive the full 10 kc frequency range broadcast by the better AM stations. Entirely new IF and detector circuits make this possible for the first time.
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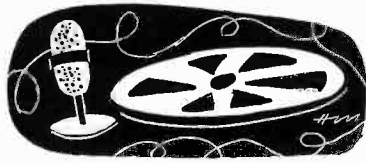
TECHNICAL SPECIFICATIONS

FM Section: 3 mv. sensitivity for 20 db quieting — 2-megacycle wideband detector — 80 db rejection of spurious cross-modulation response by strong local signals — automatic gain control — equipped for multiplex. AM Section: 1 mv. sensitivity — 10 kc whistle filter — extended frequency response to 10 kc — ferriloopstick antenna — output jacks for binaural — beautiful accessory case \$9.95*
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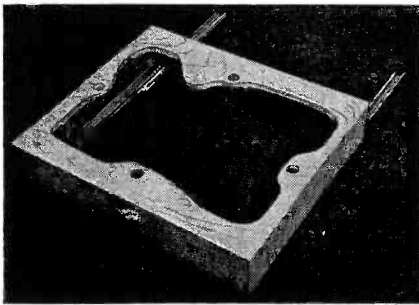


AUDIONEWS

Cabinart "Accessories" Line

For 1955-56, Cabinart is introducing a new line of custom hi-fi accessories. In the new line are 20 cabinet kits, 11 unpainted cabinets, the Klipsch-designed Rebel series of speaker enclosures, and a 10-unit "storagewall".

"Accessories" include the ACC-1, an assembled turntable or record changer base, pre-cut, and with pre-mounted slides for home installation. The ACC-1 retails for \$9.90. Another turntable mounting is ACC-2, which incorporates a rubber-mounted top, a precision, circu-



ACC-1 turntable base.

lar level, and 4 pre-mounted, rubber-tipped, adjustable screws for speedy and accurate leveling of the turntable. The ACC-2 is available in mahogany, korina, and walnut; lacquered and hand-rubbed. The unit is pre-cut and sells for \$24.90. The ACC-2U, a smooth-sanded, ready-to-finish birch copy of the ACC-2, retails for \$19.95.

The "Levelor", Model ACC-3, is a kit containing the hardware described for the ACC-2 and ACC-2U. Price of the "Levelor" kit is \$2.10.

Cabinart "Accessories" items are available through dealers.

Do-It-Yourself E-V Patrician IV

The Patrician IV high fidelity 4-way reproducer is now available in a utility, do-it-yourself system from Electro-Voice.

Step 1 gives you the E-V Model 103C Package of Patrician IV 4-way driver components at \$348.00. You may build the interior horn assemblies yourself or add the E-V Model 115 "K" horn for a complete 4-way system.

Step 2 gives you the Model 115 "K-type" basic low-frequency driver horn to add to the Model 103C components for a complete Patrician IV speaker system.

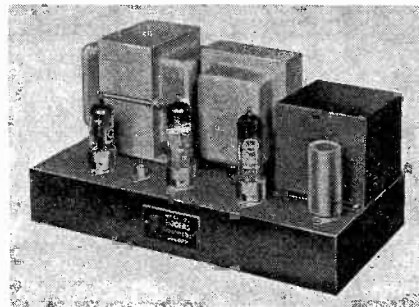
The 115 "K" utilizes the Klipsch principle of folded corner-horn loading with extended taper rate down to 35 cps. It includes integral mid-bass exponential horn bell drilled to accept E-V Model A8419 low-frequency horn sections. Black matte stain. Can be painted by user, but will not take furniture finish. Dimensions: 57½" high, 37½" wide, and 26½" deep. Shipping weight: approximately 150 lb. Price: \$180.00, audiophile net.

Steps 1 and 2 give you the Models 103C and 115, ready to assemble and operate (except decorative outer housing) at \$528.00. Frequencies up to 200 cps are handled by the low-bass, folded-horn driving section. A separate mid-bass section takes over to 600 cps. A specialized treble driver and diffraction horn reproduces the range from 600 to 3,500 cps. Frequencies above 3,500 cps are carried by the E-V Super-Sonax. Level controls are provided for proper balancing.

For complete information, write for Bulletin 220 to Electro-Voice, Inc., Buchanan, Mich.

Ercona Marketing British-Built Amplifier

Ercona Corporation (Electronics Division) announces that it is prepared to market amplifying equipment manufactured by the Rogers Development Co., of London, England. Rogers' equipment is in the moderate-price range.



Rogers "Cambridge" amplifier.

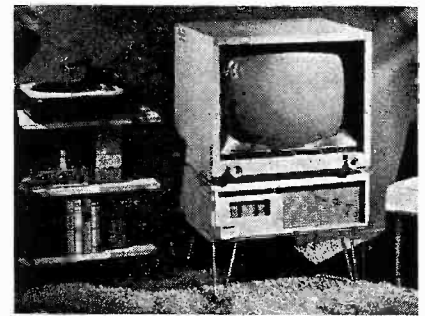
Readers desiring additional information about this line should write to Ercona Corporation (Electronics Division), 551 Fifth Ave., New York, N. Y.

Jensen Introduces TV Duette

The Jensen Manufacturing Company is now producing a line of TV Duettes de-

signed to increase the sound quality of TV table model sets.

The TV Duette replaces the small, side-mounted speaker of the TV set. A three-position switch at the front of the unit allows the listener to use either the set's original speaker or the TV Duette for television, and the Duette for any other piece of equipment, such as a changer, amplifier, or tape recorder, for which a speaker is needed.



TV Duette.

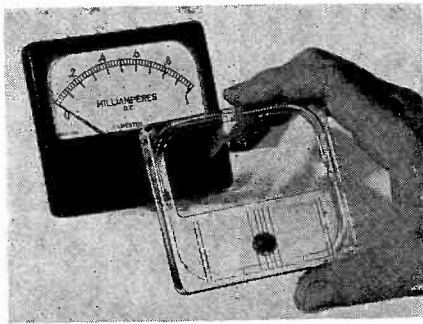
Four TV Duettes are offered at prices ranging from \$49.50 to \$85.50. Further information may be obtained from the Jensen Manufacturing Company, 6601 S. Laramie Ave., Chicago, Ill.

Weston Snap-on Plastic Front Instruments in Colors

The new Weston Model 1331 line of flush rectangular instruments incorporate the Weston self-shielded Cormag movements which eliminate all inter-effect when instruments are mounted closely on the same panel, and permit mounting on magnetic or non-magnetic panels without special adjustment. The instruments have a one-piece snap-on front with zero corrector; and the entire front surface, except for the window area, can be supplied in any color, including black, for quantity built-in requirements. Case dimensions are 3.80 in. by 3.44 in., the same as other 3½-inch Weston rectangular instruments. Available as DC and rectifier-type AC instruments in popular ranges. For complete literature, including prices, write Weston Electrical Instrument Corporation, 614 Frelinghuysen Ave., Newark 5, N. J.

Ways To Use a Tape Recorder

Magnecord, Inc., tape recorder manufacturers, have published a booklet entitled *207 Ways To Use a Tape Recorder*.



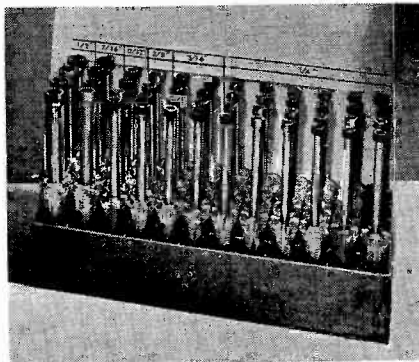
Weston Model 1331

As indicated by the title, the booklet outlines, briefly, 207 uses for a tape recorder, segregating these 207 uses into classifications such as professional, educational, church, business, recreation, and so on. It also illustrates how to record and play back and gives ways to "splice in", preserve, and use a tape recorder.

If you want a copy of this booklet, send your request and 25 cents to Mag-necord, Inc., 1101 South Kilbourn Ave., Chicago 24, Ill.

Tension-Grip Nut Drivers

The International Resistance Company of Philadelphia has come to the assistance of television and radio servicemen — and, incidentally, of hi-fi do-it-yourselfers — with a "Tension-Grip Nut Holding Nut Driver". This instrument, described as being "ideal for close work starting or removing", has a tempered steel band that grips the nut or hexagon head screw automatically as it enters the socket — and will not drop it. The "ten-



IRC's Tension Grip Nut Drivers.

sion-grip" has a spring action and is non-magnetic. It handles brass and stainless steel nuts as well as regular types. The nut driver shaft is set in a shock-proof plastic handle. The device is available in six sizes: 1/4", 5/16", 11/32", 3/8", 7/16", and 1/2".

"Super Thin" Audiotape

A new, super thin Audiotape which allows 2,400 feet of tape to be wound on a single 7-inch reel has been announced by Audio Devices, Inc. Super thin Audiotape is made on a base of

Continued on page 8

Save Money

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Hi-Fi

get custom quality
at low cost in
ALLIED'S own KNIGHT
amplifier kits

Allied's KNIGHT Kits give you the last word in Hi-Fi design and value... and they're easy to build from crystal-clear manuals featuring exclusive "Step-and-Chek" assembly, "King-Size" diagrams and "Spotlight Pictorials." Save money—get true Hi-Fi quality with these KNIGHT Kits.

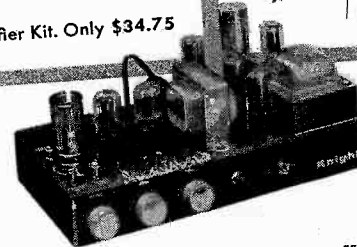


Model S-750
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Easy to build for professional results in your own fine home music system. Features wide frequency response, ± 1 db, 20 to 20,000 cps; full 20 watts output using push-pull 6L6's; built-in preamp; separate bass and treble tone controls; compensation positions for 78 and LP records. Distortion, 1% at 20 watts. Hum and noise level: Tuner input, 90 db below 20 watts; magnetic phono, 72 db below 20 watts. Sensitivity: Tuner input, 0.6 volt for 20 watts output; magnetic phono, .007 volt. 4 inputs: Magnetic phono, tuner, microphone, and crystal phono or recorder. Controls: Bass, On-Off-Treble, Volume, Selector. Speaker outputs: 4, 8, 16 and 500 ohms. Complete with all parts, tubes (12AX7, 2-12AU7, 2-6L6G, 5V4), punched chassis and instructions. Shpg. wt., 23 lbs.

Model S-750. Knight 20-Watt Hi-Fi Amplifier Kit. Only \$34.75



Model S-234
\$20⁹⁵

KNIGHT 10-WATT HIGH FIDELITY AMPLIFIER KIT

A "best buy" Hi-Fi amplifier remarkable for wide response, low distortion and smooth reproduction—extremely easy to assemble. Output is adequate for any home installation. Frequency response, ± 1 db, 30 to 20,000 cps at 10 watts. Harmonic distortion, less than 0.5% at 10 watts. Intermodulation distortion, less than 1.5% at 10 watts. Push-pull output. Input for crystal phono or tuner. Controls: On-Off-Volume, Bass, Treble. Matches 8 ohm speakers. Complete with all parts, tubes (2-6SN7GT, 2-6V6GT, 5Y3GT), blue-wrinkle finish chassis (punched to accommodate preamp kit listed below). Wt., 14 lbs.

Model S-234. Knight 10-Watt Hi-Fi Amplifier Kit. Only \$20.95
Model S-235. Preamp Kit for wiring into above. Only... \$2.75



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EDITORIALS

THERE are, basically, two ways in which the editorial content of a magazine such as AUDIOCRAFT can be determined. The editors can aim for a general type of reader, procure editorial material they believe would be interesting to him, and thereafter have nothing to do with him—let the Circulation Department worry about getting and keeping him in large enough numbers. Alternatively, they can stay in close touch with readers as circulation grows, find out what interests them most, and obtain for them exactly the articles most of them want. We have followed the latter course from the beginning on our sister publication, HIGH FIDELITY, as will be evident on comparison of an early issue with later ones. We've done this not only because it seemed to us a moral responsibility but also, frankly, because we found that it's good business: the subscription renewal rate is higher, readers respond more readily, advertisers get more for their money.

Naturally, we expect to serve subscriber interests in the same way on AUDIOCRAFT. To that end many readers will receive survey questionnaires from time to time. We ask now that you take the time to complete and return them, since they will play a large part in determining our future editorial content. Further, we offer assurance that any unsolicited suggestions will be considered most carefully. And finally, we extend sincere thanks to those who have made comments and suggestions already; these have been received in such number that it is impossible to acknowledge them all individually. Yet they have all been read—and will continue to be read—by our editorial staff.

This is not to say that we expect to change the basic theme of AUDIOCRAFT drastically or even gradually; if we had been at all uncertain that a magazine of this type and with this approach were needed, you would not be reading this page now. It would probably be best, then, to state our editorial direction at the beginning:

1) We intend to cover the field of sound reproduction from the "how-to" angle primarily, and the "why" angle secondarily. There will be a preponderance of articles on construction of electrical and mechanical audio components, their maintenance, and allied subjects. There will also be an appreciable number of pages devoted to basic and advanced audio theory.

2) Since the technical erudition of readers—if not their aptitude and dexterity—will vary appreciably, articles will be furnished for the more advanced

as well as those with limited experience.

3) Because cabinet alteration and construction, and speaker enclosure assembly, are both subjects properly related to sound systems, editorial coverage of woodworking will be represented by a regular department and occasional articles. Tape recording equipment and techniques will receive extensive treatment also.

4) We will publish an article occasionally that is controversial in nature; that is, it will present one viewpoint on a debatable subject. There is at least one in this issue. Factual statements that we know to be untrue will not be allowed, needless to say, but we may agree or disagree ourselves with *opinions* expressed in such articles. Rebuttals, either as complete articles or letters to our *Readers' Forum* department, are encouraged. Every effort will be made to publish them.

5) Our format and style will not be popularized to the extent of using pulp paper and bad grammar, but neither will this be a professional-type magazine. We shall be concerned more about maintaining integrity and accuracy than undue dignity, and reasonably good taste more than formality. To further these aims we will build and test every non-commercial unit of electrical equipment whose design we publish, and will add the results of our tests to these articles. We intend to use paper that won't disintegrate within a year, to use side-stitching from the first issue, to make volume numbers coincide with the year's end, and to publish an index in the last issue (December) of each volume. This will facilitate binding the issues according to volumes. Incidentally, the two issues of 1955 will be included with 1956 issues in Volume I.

6) We shall not restrict the subject matter entirely to hi-fi sound as such, though we expect that most articles will deal directly or indirectly with high fidelity.

It is within the framework of these policies that we shall be guided by your attitudes and specific suggestions.

AUDIO initiates will understand and forgive our glow of pride in the impressive list of authors we managed to corral for our first issue, particularly in view of the short time we had in which to accomplish it. Who doesn't know of R. D. Darrell, one of the first and most eminent record reviewers, and highly respected audiophile-philosopher extraordinary, whose article begins on page 33? There are also Karl Kramer, a leading loudspeaker and speaker sys-

tem design engineer, who describes in detail how to build his "laboratory standard" system; Joseph Marshall, well-known writer and audio experimenter; Irving M. Fried, highly-reputed hi-fi expert and dealer in Philadelphia; William C. Bohn, his counterpart in New York; John E. Lauer, university professor and long-time audiophile; George Bowe, well known in New England as a WTIC radio personality; and so on, including several staff members. Upcoming are articles by such authorities as (alphabetically) Oliver Berliner, R. T. Bozak, Charles Fowler, David Hafler, Glen Southworth, Rufus P. Turner, and Edgar M. Villchur. Looks like interesting and substantial fare; better get in your subscription if you haven't done it yet! There are handy postage-paid cards bound into this issue and, if you get one in the mail before November 1, you can take advantage of the special Charter Subscriber's rate.

AUDIO show time is upon us, and many will read this just before, during, or immediately after attending one of the many shows throughout the country. We wonder how many will leave (or have left) with a clear impression of what they heard? Not many, if the shows follow the pattern established in previous years—loud, attention-getting music played under most unfavorable listening conditions. Hardly typical of the way you'd use equipment at home. Remember that an audio show is a demonstration, and to demonstrate something with effectiveness, its function or performance must be exaggerated in nearly all cases.

We aren't saying that audio shows should (or could) be much different under the circumstances. Nor do we deny their utility in acquainting the public with high fidelity sound, which is vastly more impressive heard than described. What we do say, though, is this: don't try to decide on specific equipment solely by what you hear at a show. Look it over and listen, but before buying listen carefully and long under less trying conditions at an audio dealer's showroom. Listen to a new pickup, for example, over a system similar or identical to your own, and compare it with other pickups in the same price range. Hear them both at high and low sound levels, and on various kinds of music. Careful comparative tests such as these are essential to reveal differences among competitive equipments, and they are impossible in a small crowded room at an audio show.

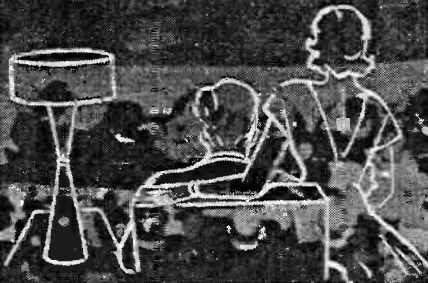
— R. A.

A NEW WORLD OF ENCHANTMENT IN SOUND

Permoflux

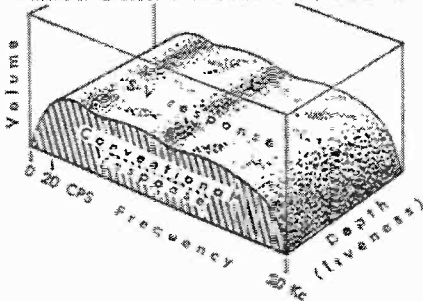
STEREO-VOX

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from monaural sources**



LIVE FIDELITY—Greatest Development in Audio Since the Electronic Phonograph

Graphic portrayal of S-V sound, showing how 3rd dimension is added to conventional response curve



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NET\$48.50



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Imp., 8 ohms.
NET\$29.85



Royal Model 8T-8-1, 5" speaker.
NET\$13.50

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AUDIONEWS

Continued from page 5

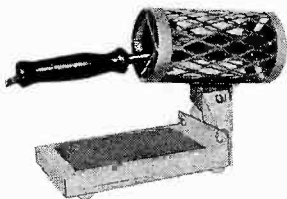
1/2-mil thick DuPont Mylar polyester film. The magnetic oxide coating is the same as on other thicknesses. The tape is available in the full range of recording tape widths and reel sizes.

Designed particularly for special applications, the new thin-base Mylar gives unbroken continuity for very long recording needs, although the thin tape is less strong and will exhibit more print-through than heavier types. Signal to print-through ratio for the super thin tape is 47 db, as compared to 51 db for LR Audiotape (on 1-mil Mylar).

Further information may be obtained from the manufacturer, Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

Soldering Iron Holder

The Wilder Manufacturing Company, Inc., produces a Soldering Iron Holder which many readers may find useful. The holder is adjustable and avail-



Soldering Iron Holder.

able with or without wiping pad attachment as illustrated. When not used with wiping pad, the holder can be fastened either under bench, shelf, or on top of bench in any position required. This item prevents the operator from coming in contact with the hot iron and provides a permanent position for the iron when not in use.

Further information and literature are available from the Wilder Manufacturing Company, Inc., Mechanic St. and Erie R. R., Port Jervis, N. Y.

University Line

University Loudspeakers, Inc., of White Plains, New York, has announced the addition of a number of new items to its line. We list some of the additions here very briefly: if you want more information about any of them, we suggest you consult your dealer or write to the manufacturer.

The Model S-1 "Companionette" is a 2-way speaker system using the University 4401 wide angle tweeter and the C8W woofer. The "Companionette" is designed for limited space application or for use as an extension speaker to an existing high fidelity installation. Price: \$59.50.

The "Tiny-Mite" speaker system and enclosure is a 3-way system utilizing a Model 308 Triaxial Speaker and is designed for use either as a corner installa-

tion or against a flat wall. Price of the enclosure with speaker is \$75.75. The enclosure alone in finished cherry mahogany or blond is available as model TM-8 for \$39.75; unfinished enclosure is available as model TM-8U for \$34.00.

Model EN-12 enclosure is suitable for full-range 12-inch speakers and multi-speaker combinations using a 12-inch speaker for a woofer. The enclosure employs the horn-loaded bass reflex principle. This item is available in cherry mahogany or blond finish at \$75.00; unfinished at \$64.50.

Model EN-15, big brother of the EN-12, is suited to 12-inch or 15-inch full-range speakers and multi-speaker systems. Designed for use either in a corner or against a flat wall, the EN-15 employs the same horn-loaded bass reflex principle as the EN-12. Available in cherry mahogany, blond, or walnut finish at \$125.00; unfinished at \$102.00.

Model CIB wide-angle paging speaker boasts high output with "maximum intelligibility and noise penetration". This speaker is designed for use in public address systems. CIB is available in 8- and 4-ohm models at \$40.00 and \$42.00 respectively. Also available is smaller CMIL; 8- and 4-ohm models priced at \$28.75 and \$30.00 respectively.

The Model AP-8 "Balance" Control is an attenuator pad for use with speakers and crossover networks to balance sound according to room acoustics and personal taste. Price is \$6.25 list and \$3.75 "User Net".

Institute of High Fidelity Manufacturers

The Institute of High Fidelity Manufacturers, an organization whose membership list includes many of the foremost manufacturers of high fidelity components, has recently adopted an identifying emblem. This insignia was designed by one of the members, Mr. Avery Fisher of Fisher Radio.

The emblem will be used on all official literature and will also be available to members of the Institute for use in advertising and promotion.

For further information regarding the Institute and its activities, write to: Institute of High Fidelity Manufacturers, 25 Broad St., New York 4, N. Y.

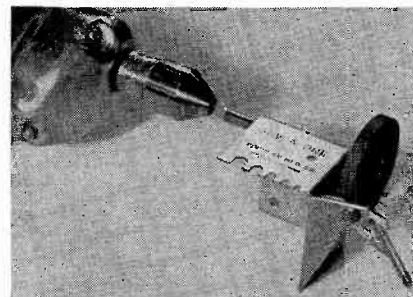
MEMBER
INSTITUTE OF



Drill Sharpening for Everyone

A low-cost drill sharpener, complete with grinding wheel, is now available from the Popular Manufacturing Co., of Minneapolis, Minn.

Known as "Sav-a-drill", the sharpener uses the power from any electric drill and will handle any size drill bit from



Popular's "Sav-a-drill".

1/16 to 1/4 in. Its 2-inch grinding wheel is mounted on a 1/4-inch shaft which is cradled in permanently lubricated bronze bearings. An extension of the shaft fits the chuck of the electric drill. The "Sav-a-drill" drill holder is pre-set at an angle of 59 degrees.

"Sav-a-drill" is \$2.95, complete, and is available direct from Popular Manufacturing Co., 4115 Glencrest Rd., Minneapolis 5, Minn.

Bogen Receiver and Challenger Amplifier

David Bogen Company, Inc., 29 Ninth Ave., New York 14, N. Y. has announced the addition of two new items to its line of products.

The first is a new FM-AM receiver, known as the RR550. Specifications indicate an FM sensitivity of 2 1/2 microvolts for 30 db quieting (70 ohm input measured using I.R.E. standards). AM sensitivity is 5 microvolts for 20 db signal-to-noise ratio. The RR550 incorporates a tuning meter operative on both AM and FM, an AFC defeat switch, a built-in ferrite loop for AM, and a built-in line antenna for FM. Provisions are made for the use of external antennas including 70-ohm unbalanced and 300-ohm balanced. It is complete with preamplifier and has inputs for magnetic and crystal phono cartridges. Frequency response is said to be 15 to 40,000 cycles, ± 1/2 db; distortion less than 1/2% at 25 watts output. The amplifier controls include separate bass and treble tone controls, a 3-position loudness contour selector, a 5-position phonograph equalizer, and separate hiss and rumble filters controlled from the front panel.

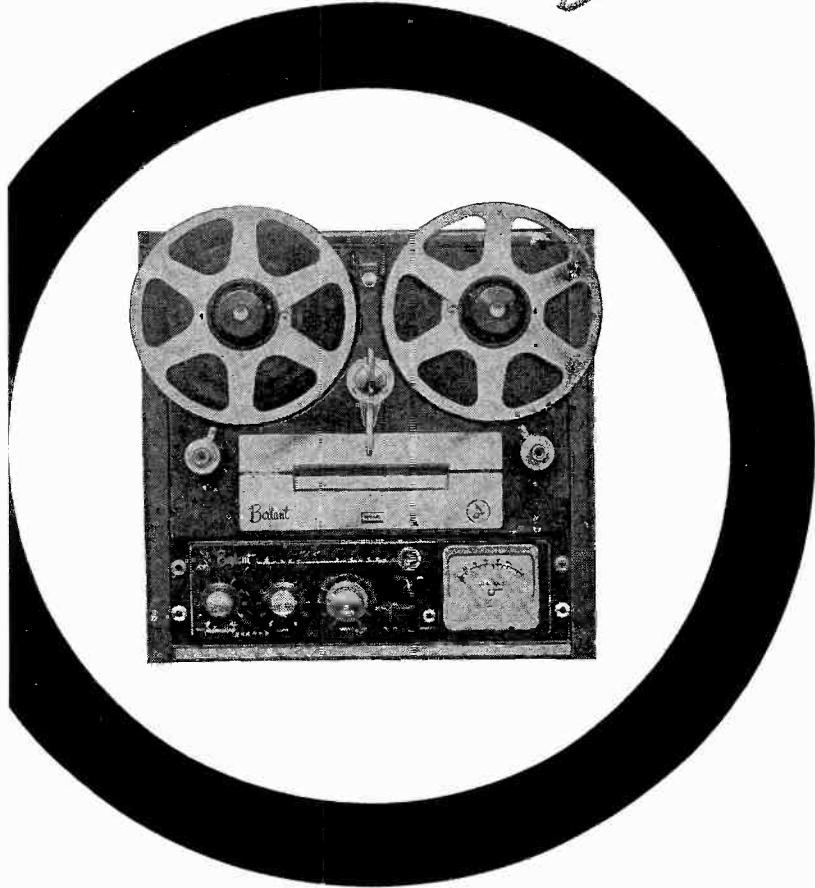
The RR550 is available in chassis form at \$220.00. Blond and mahogany enclosures with removable legs are available for \$8.00.

The Challenger model HF8A is the

Continued on page 45

What is the difference
between Amateur and
Professional tape recorders?

amateur	professional
2 heads	3 heads (provision for additional heads) The third head makes it possible to check the sound for proper balance while recording. Extra heads allow simultaneous recording and playback, sound on sound recording, stereo recording, etc.
1 motor	3 motors. Separate motors for take-up and supply ensure constant speed, permit faster forward and reverse. Additional motors for direct drive reduce distortion by eliminating clutches, belts, pulleys.
3.75 & 7.5 ips speeds	7.5 and 15 ips speeds. Most professional recording of tape masters is done at 15 ips. The faster the tape speed, the less flutter and wow.
Electric eye level indicator	Large signal level meter for accurate measure of input and output in order to reduce distortion due to overmodulation.
7 inch reels	10½ inch reels provide 1½ hours of recording. Entire operas and symphonies can be recorded without interruption.
None	Two channel input mixer allows recording of narration or song over music with independent volume control on each channel.
None	A-B Test Fader permits, while recording, monitoring for direct comparison of sound coming in with sound as recorded on tape, in order to achieve perfect reproduction.
None	Special Cueing and Editing positions for quick, accurate cueing and editing.
	Dependability of operation, timing accuracy, precision construction, exacting quality control are additional professional features.
	Take this handy check list with you when you go to buy a tape recorder!



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carrying cases
for complete
portability

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BERLANT BRX-1745 & BRX-2745: Recorder in a set of newly styled carrying cases, containing matched 10 watt amplifier and 2 extended range speakers. User net price, complete **\$745**

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Berlant & Concertone

The Grounded Ear *by Joseph Marshall*

Mullard Circuit

We have had several new power output stage configurations in the past year or two but, in general, amplifiers have pretty closely followed the circuitry of the Williamson. In a real sense the Williamson circuit has become a design pattern so thoroughly dominating the minds of many engineers that it has apparently placed a mental block in the way of independent and original thinking. But it is still possible to come up with a new (and excellent) design approach, as proven by the circuit of the Ampex 620 amplifier whose performance has so pleasantly astonished most listeners. This circuit, too, comes to us from Britain, off the boards of the Mullard Tube Company engineers.

The interesting portion of the circuit is the front end (Fig. 1 gives the Ampex version) containing the voltage amplifier and the phase inverter. It is extremely simple in principle but possesses virtues beyond those that first meet the eye. It consists merely of a high gain voltage amplifier—a pentode in this instance—direct-coupled to a cathode coupled or “long-tailed pair” inverter.

The cathode coupled inverter, most authorities agree, is superior to the split-load type used in the Williamson. It is better balanced to begin with and maintains or forces balance by means of the large common cathode resistor. Push-pull operation has little advantage if the balance is not very good; indeed, a badly balanced p-p amplifier may have more, and more unpleasant, distortion than a good single-ended one. Since the inverter establishes the initial balance and its balance affects the entire p-p chain, it is highly desirable that it be capable of being balanced throughout its entire frequency and dynamic range and, preferably, of forcing balance also. The split-load type does not meet either requirement. Those wedded to it will retort that while this may be true theoretically, in practice it works well enough and cite the excellent performance of Williamson amplifiers as evidence. This may be true; but ideals are not approximated by expedients which merely work “well enough” or designs which are merely adequate.

The long-tailed pair does have the disadvantage (though not as compared with the split load) of requiring special measures to realize any gain. The large cathode resistor presents biasing problems and also produces considerable degeneration which is fine from the distortion and frequency points of view but which does reduce gain markedly. The

beauty of the Mullard circuit is that the direct coupling to the preceding amplifier solves these problems in one rather breathtakingly simple swoop. For direct coupling places the grid at a potential approaching that of the cathode; it is easy to juggle cathode and grid voltages to produce normal biasing and thus to obtain about half the gain possible from the same tube used as a simple amplifier. By preceding it with a high gain amplifier it is quite possible to eliminate one entire stage and end up with a three-stage amplifier, as against the Williamson's four stages, and only one internal time constant as against the two in the Williamson. And this has advantages far beyond mere simplicity and economy.

The reduction of a stage and time constant means less phase shift at both ends of the pass band and this, in turn, greatly reduces the problem of obtaining high feedback factors with adequate stability and minimum ringing. So we can get the same amount of feedback with less ringing and higher stability, or higher feedback for the same ringing and stability factors. This, in turn, can produce even better quality with the best components and very much better quality with inexpensive components.

The biggest problem with present versions of the circuit is the difficulty of obtaining more than 20 volts of output from the inverter. As it stands, the circuit (even with a 12AX7 instead of the 12AU7) will not deliver much over this and therefore is most useful with pentode operation of output stages in which such low drive can produce maximum

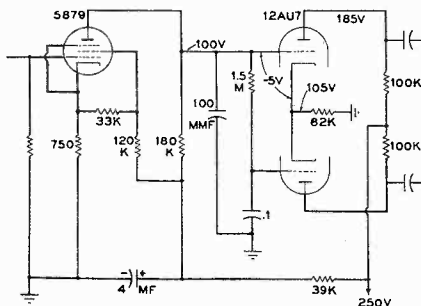


Fig. 1. New power amplifier drive circuit.

output. It is not readily applicable to triode or Ultra-Linear operation, which requires about 40 volts of drive. Recent commercial designs (notably the Pilot AA904) have shown that pentode operation can produce extremely low distortion with high damping factors; perhaps the Mullard circuit will stimulate and accelerate the use of pentode output stages. In any case, it is merely a matter

of time until somebody comes up with the right combination of tubes to deliver 40 volts of output. Meanwhile you'll be seeing the Mullard configuration in the front end of the new McIntosh amplifiers and, I have no doubt, in inexpensive amplifiers using the 6V6, 6AQ5, 6AR5, and especially the new British EL84 tubes.

New Audio Tubes

It has been some time since we've had a new power tube specifically designed for audio service, but the past six months have brought us at least three most interesting bottles. All three are pentodes. Theoretically a pentode should have lower distortion than a beam tetrode or beam pentode; indeed, many designers have noted that a pair of 6K6's, for instance, will deliver lower distortion, despite higher drive, than a pair of 6V6's.

The first to be introduced of the new three is the Tung-Sol 6550, which has a dissipation rating of 35 watts instead of the 20 to 25 watts of the 6L6-807-KT66 family. Used as pentodes a pair of 6550's can deliver 55 watts in Class A with around 400 volts on the plates, 275 on the screens, a plate-to-plate load of 3,500 ohms, a current swing of 180 to 270 ma., and a bias of only 23 volts. As triodes they can deliver 28 watts with 400 volts on the plate, a 4,000 ohm load, a current swing between 150 and 220 ma., and a bias of 45 volts. Both David Hafler and I have obtained more than 50 watts from a pair in Ultra-Linear with 400 to 440 volts on the plates and screens, a bias of 45 volts, a current swing between 150 and 240 ma., and a load of 3,300 ohms provided by the Acro TO-330 transformer. Hafler reports that Williamson amplifiers are easily converted for higher output simply by replacing the tubes and transformer and adding a simple bias supply. Acro Products has a conversion bulletin.

The 6550 is not quite as linear as the KT66, but the disparity is smaller than that between the KT66 and equivalent American tubes. Four balanced KT66's produce somewhat lower distortion than a pair of 6550's but the difference is largely academic. I'm certainly not advocating a power output race, such as the horsepower race in automobiles—I am dismayed at the tendency in that direction*; still, the 6550's should be just

Continued on page 40

*The 6550's don't have to be used for the purpose of getting extra watts. Altec Lansing, in the first commercial unit employing these tubes, operates them very conservatively (25 watts) so as to increase reliability and service life. The amplifier is model A-340A.—Ed.

READERS' FORUM

Gentlemen:
My very best of enthusiastic congrats — *about time!*

Have been considering subscribing to various other magazines for just the stuff you people now seem to be hitting.

Hints: woodworking; baffles; also tips on comparisons of enclosures; kits (amp and preamp); several small speakers *contra* few big; types of transformers. Just give 'er the works, fellows. You may start a minor landslide.

A. Groner
Kamloops, B. C.

Gentlemen:

. . . By all means, please enroll me as a Charter Subscriber to AUDIOCRAFT! Judging from the information given in your announcement, it should give me all of the things I now have to take three magazines to cover—a saving equivalent to three additional 1,200-foot reels of tape a year!

On the chance that you may still have some unobligated space in the new magazine, I offer a few suggestions. First, I believe the new magazine will appeal to the type of reader who would appreciate record and tape reviews written for the hi-fi hobbyist . . . reviews that would tell something about the microphone perspective and recording level used, the treble cutoff point and attenuation slope needed to eliminate surface noise, the bass cutoff point and attenuation slope needed to eliminate any rumble or reverberation . . .

Then, I believe it would advance the "cause" of hi-fi to include a department on *Factors to be Considered in Buying Your Home Music System* . . . which would, in effect, warn prospective hi-fi buyers concerning things *not* to do in planning home music systems, and in selecting and purchasing system components.

Another department I think might be popular . . . would be a reader-participation forum dealing with questions of basic hi-fi theory and practice . . .

I should be interested in learning what other readers may have developed in the way of home music systems . . .

R. R. Lowdermilk
Alexandria, Va.

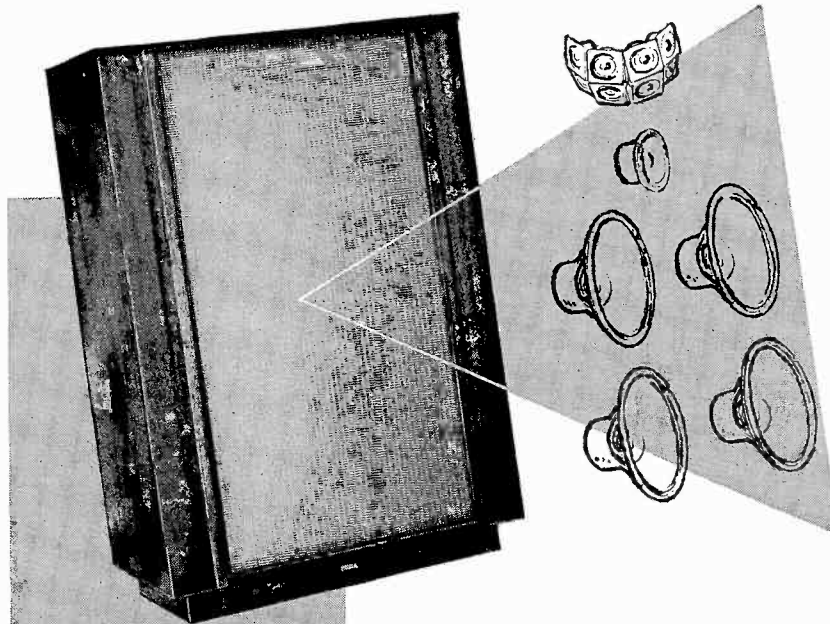
Gentlemen:

. . . You ask for suggestions as to the make-up of AUDIOCRAFT—I suggest that you make it especially practical, with articles on *How to Make* and *How to Do* and *Build It Yourself*.

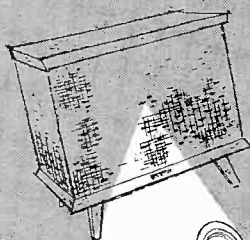
Personally, I should like to see articles on disc recording as this has been my hobby for the past 30 years . . .

Wishing you success.

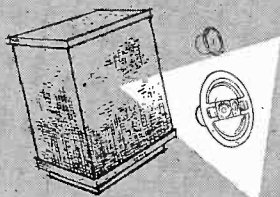
H. A. Waggner, M.D.
Hollywood, Calif.



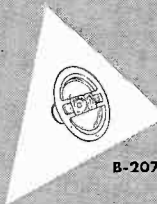
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B-305



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B-207A

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Tape News and Views

by J. Gordon Holt

Compatibility . . . a Sour Note

A mere two or three years ago, the American record industry found itself sitting in the middle of a massive controversy over a little matter called equalization.

The public, on the one hand, was raising a din to the skies, clamoring to know what company used what equalization for what records; and the trade magazines and component manufacturers were rattling the saber for standardization, and suggesting this curve and that curve as the most satisfactory compromise.

The whole nasty business had many of the recording companies in paroxysms of indecision, particularly those that weren't quite sure what equalization was and had to delve into the current literature to find out whether or not they were using it at all. None of these companies was very eager to adopt anyone else's system as the "industry standard", since it would mean expensive equipment modifications and would render all their previous recordings obsolete.

So, they eventually hit on a compromise, the present RIAA curve, which favored very few because it made practically *everybody* obsolete.

Now the Great Crisis has subsided, most of The Majors have either converted to the new curve or claimed they were about to, and the audio purist has turned his back on records and raised the flag for tape. "Magnetic tape has arrived!" we were told, while twelve trumpets blared a fanfare for The New Medium. Tape was to be the answer to all our prayers; it spelled nemesis for confusion; it was the end of all our NAB's, ORTHO's and RIAA's. "All you do is record it and play it back!" And, believing all this implicitly, we went out and threw parties, and bought a new car, and there was great rejoicing throughout the land.

It all sounded so wonderful, in fact, that the more cynical individuals were inclined to stand off at a distance, frowning. It couldn't be *that* good! There had to be something wrong . . . somewhere.

There was . . . and there still is.

According to the record (written; not tape or disk), the first *practical* tape recorders were developed by our erstwhile enemy, Germany. Once the idea was imported, there commenced a round of feverish activity behind closed doors, while domestic manufacturers flogged their developmental coolies into a frenzy of American Inventive Ingenuity. Independently they developed, independently they designed, and independently they

came up with their own American prototypes of the original German machine.

And, incidentally, they also came up with their own independent and unique equalization systems, which dictated that a tape made on one machine could be played back on that machine *only*.

This was just the start of the fun, however. Within the next few years, tape recorders were sprouting like broccoli from every nook and cranny, until we find ourselves today with five different tape speeds, full-track heads, half-track heads, stacked binaural heads, staggered binaural heads, narrow head gaps, "wide" (not as narrow as "narrow") head gaps, and more systems of equalization than you can shake a slide rule at.

Magnetic tape has arrived! And the old equalization problem is with us again, together with a few new ones. Actually, there *has* been a meeting of minds over the matter of tape equalization, with the recent adoption of a standard playback curve for pre-recorded

tapes of his equipment and learn to live with them. Of course, if he intends only to play his tapes on his own machine he may sit back and breathe easily. Any recorder will, of course, play its own tapes admirably. It's just when we try to swap tapes, or play pre-recorded tapes, that we begin to get in trouble.

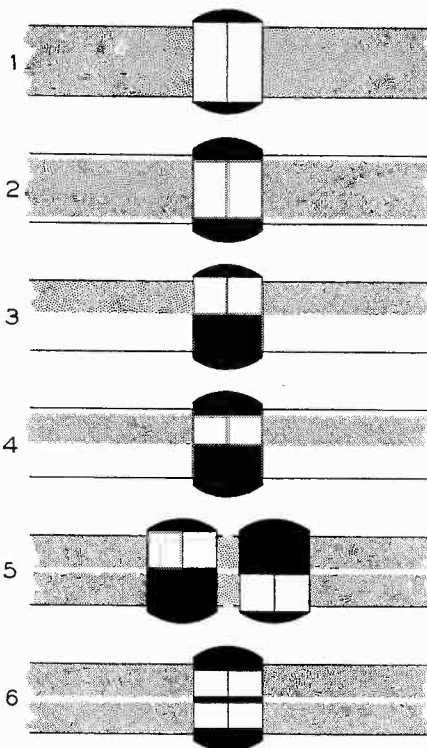
Bypassing the ugly equalization problem for a while, though, let's take a look at the matter of head configuration. Figures 1 to 6 show a number of different track systems for laying sound on magnetic tape. During the past few years of recorder production, all these were being used by different manufacturers, and the results were eminently satisfactory, as long as the tapes were played back on the recorder they were made on. But now we have scores of active tape correspondence clubs flourishing from Brooklyn to Bangkok, and their members know very well what is meant by incompatibility of playback heads.

As an ideal case, let's take this fabricated and much-contrived "example". Let's say a tape correspondent in Sydney, Australia, owns a recorder with a full-track record/playback head that covers the entire width of the tape, as in Fig. 1.

Hopefully, he sends a tape letter to another correspondent in Boise, Idaho, whose full-track heads leave small margins of unrecorded tape, as in Fig. 2. Boise plays it back perfectly, we may assume (?), and puts it aside. Then he takes another tape and records his answer to Sydney's letter. Next day, he uses Sydney's tape to record a message to a third correspondent in Swarthmore, Pennsylvania, erasing the original cleanly, as far as he is concerned, but actually leaving two narrow margins of the original recording on the tape, which of course he is unable to hear on playback.

So Swarthmore, who uses half-track heads of the type in Fig. 3, plays the tape. He hears Boise's letter, all right, but he also hears one of the marginal remnants of Sydney's letter, which Boise's recorder couldn't erase. However, he can still make enough sense out of Boise's tape to get off an intelligent answer, which he does on another tape. Then he decides to send a tape to yet another correspondent in Oakland, California. He uses the tape from Boise, erasing and replacing half of Boise's message and one marginal left-over from Sydney's letter.

Oakland, whose recorder has a head set-up like Fig. 4, hears only the message from Swarthmore. But when his next



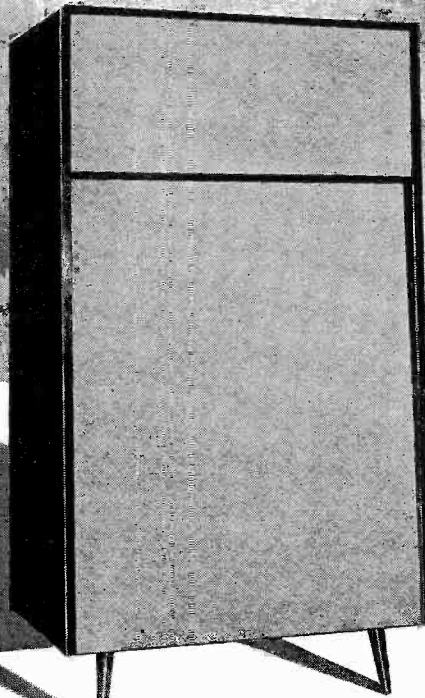
Figs. 1 through 6. Tape recorder head arrangements. Shading in Fig. 6 should not extend fully to edges of the tape.

tapes, but the damage has already been done, since myriad hybrid machines are already in circulation. So the best that the present owner of a "non-standard" tape recorder can do is realize the limi-

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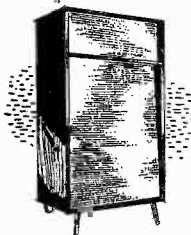


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SOUND SERVICING

by Irving M. Fried

Record Changers

The record changer, as its name implies, is an instrument devoted to two purposes. Serving two masters, it can get into at least twice as much trouble as a comparatively simple, one-function turntable or record player. Every changer has these two purposes: to play records, and to change records. Certain of its parts, naturally, are involved in both the playing and the changing functions, and these are the parts that produce troubles unique to changers. Other parts are subject to the same kinds of difficulties that afflict transcription turntables and arms.

From my point of view—that of a hi-fi “doctor”—the result of this split personality is logically a higher sickness rate among changers than among any other class of high fidelity components. As with other high fidelity problems, some changer troubles require professional services, but others can be cured or at least ameliorated by the layman. For instance, everyone has seen the arm of a changer stuck in a groove, because some lever underneath was snagging the arm, or has heard assorted and mysterious noises in the final sound. Changers have little peculiarities of their own, some of which will be described below, with suggested cures. Of course, these tips are not intended to replace a good instruction manual, which should have come with your particular changer, nor do they replace a real set-up job by a professional audio specialist, for those fortunate enough to have access to one.

Speed Troubles

One frequent complaint—occurring not only in changers but also in turntables—is that of rumble, flutter, or wow; i. e., of speed irregularities. It is a situation that varies from make to make, and from unit to unit of each make. Let us assume that you somehow got a bad one, and that your record reproduction is suffering. What can you do?

First of all, if you are lucky enough to be within the standard three-month warranty period, take it back to your dealer. Insist on another one, or a different brand that works properly. If your dealer is equipped to set up changers, let him do it, even at extra expense, for he then is obligated to guarantee its proper performance. Don't let your dealer pass the buck by saying, “A changer is a changer”; for, rest assured, some of the changers available today can satisfy all but the most critical ears in

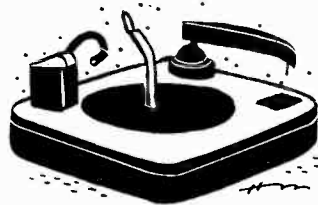
regard to speed regulation and freedom from rumble.

If by sad chance you are left to your own devices, you can still improve the operation of your changer (or turntable). As always, the first step in the cure is to diagnose the trouble—to determine what causes the phenomenon that is bothersome: rumble, or flutter, or what have you.

Step 1 is to check the motor. Take off the turntable; turn on the motor and put your hand on it. If you can feel strong vibration or pulsation you have an unbalanced motor, which can raise hob with record playing. There is very little one can do locally about that. The better modern changers have dynamically balanced rotors, but occasionally one gets unbalanced in shipment. If yours is unbalanced, the only cure you can effect is to order a new motor.

Step 2 is to check the drive train, the system through which the motor finally drives the turntable. Currently available changers and most turntables drive either through a pulley and idler system, one wheel driving the next; or through a system of belts and pulleys; or by direct drive through a gear reduction system. Most units fall into the first category, only the Garrard RC80 into the second, and only the Thorens into the third.

Let us examine the first kind, with pulleys. Once you are satisfied that the motor is in good condition, you should



examine its driving surface. Sometimes this is a pulley on the shaft, sometimes only the shaft itself. Is the pulley tight, or has it worked loose? Turn on the motor; place your finger on the driving surface. Can you feel irregularities? If so, replace the driving pulley with one that is round. If the shaft itself is irregular you can also tell that.

When you are satisfied that the motor and its pulley are in good condition, you can check the next pulley in the drive train in the same fashion. If this pulley wobbles in and out, or up and down, or has large burrs, or flat spots, replace it. If its variations are minute try placing a

stationary file against the rotating surface, to shave them smooth. Incidentally, a small file is helpful at regular intervals to keep rubber idlers free of oil glaze and small imperfections.

Last check, of course, is the turntable itself. Turn on the entire unit, with table in place. By visually sighting the contact surface where the driving pulley touches the table, you can often spot wobbles, in-and-out-movements relative to the center, and so on. If you see any wobble here, you can be sure you will have wow (a slow speed variation in pitch). At the same time, examine this driving surface for small irregularities such as stray flocking and small bits of paint. The smoother this surface is, the better your speed regulation will be.

Before you stop, make sure you don't have grease or oil on driving surfaces, where it doesn't belong; and that you do have a *little bit* of it in all bearings. Also, be sure your bearings are clean of lint, dust, and assorted dirt. Even on brand-new changers you can often work wonders with a rag, some cleaning solvent, and a little judicious application.

Most of the suggestions concerning category one apply also to the RC80 type of changer. Obviously, the belts should be carefully checked. Are they ragged, cracked, or stretched? Replace. Check carefully to see that oil from the belt interwheel pulley bearings is not working its way up to the belts themselves.

In category three, the Thorens type of direct gear drive, more problems are caused by oil shortage than oil surplus. If you have a Thorens, keep it well lubricated—particularly the pressure pads in the governor assembly, and the end bearings in the motor-governor assembly. Other speed problems are best handled at the factory.

Arm and Tracking Problems

After problems of speed and rotational noise, the next most prevalent group, with changers, is that involving the arm. Typical troubles are the following, with suggested cures:

1) Arm doesn't drop in the right positions for 7, 10, or 12-inch records. This is usually a simple adjustment by means of a screw on or near the arm, which actuates an eccentric pawl to move the arm out or in slightly. If this adjustment won't work, or won't go far enough, your instruction manual should have supplementary instructions.

2) Arm does drop properly for certain record sizes, but not for at least one

size. This generally indicates malfunctioning in the system of levers from either the record shelf or the record feeler (depending on the design—whichever is the changer portion that “senses” record size). Try following the lever system during operation, to determine which part is not operating properly. Better still, if you aren’t mechanically apt, get the changer to your dealer or the factory.

3) Arm and stylus won’t stay in the groove during the record playing cycle. Check the following:

a Stylus force—few changers come from the factory properly adjusted for the cartridge you want to use, and fewer stay in adjustment over the months, particularly when the counterbalance is a spring. It’s better to run your cartridge a gram or two over manufacturer’s recommended force, since published figures are invariably correct only for transcription arms. The extra force reduces tracking distortion, in any case, and ensures more freedom from petty annoyances.

b Stylus condition—a worn stylus won’t stay in a groove, particularly on new records (before the groove walls have been eroded and the groove widened) with great dynamic range.

c Stylus position—if your stylus is canted one way or the other, or does not extend far enough below the cartridge body proper, record eccentricities will tend to force it from the groove. On some changers, you can level the cartridge by rotating the head; on others, you may have to shim the cartridge by inserting small washers under one screw or the other.

d Side pressure on the arm—get your changer into operation, letting the stylus lower into the first few grooves. Turn off the motor. Lifting the arm slightly, push it back and forth across the record. Motion should be relatively easy. If you feel any appreciable resistance look for dragging levers, tight arm bearings, lead wires tightly stretched, or anything else that shouldn’t be. If the resistance seems to build up in the inner grooves, the drag is probably associated with the trip lever.

e The record—a few of them are bad enough to mistrack even on good turntables. If a record won’t play on your friend’s transcription turntable and arm, you shouldn’t expect it to play on your changer.

f Cartridge condition—certain cartridges stiffen with advancing age, start to resonate with the arm, and jump right out of the groove. Remedy is either factory repair of the cartridge, or a newer, more compliant unit.

4) Arm buzzes around, with generally poor quality. Check for same symptoms as in (3), especially as regards car-

Continued on page 42

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1. Have you ever wondered which amplifier and tuner were *really* best for your needs? Many dealers and distributors will recommend whatever yields the highest profit. Others try to promote their slow-moving items and their overstock. But at High-Fidelity House we have tested *every* worthwhile audio component on the market, and we will tell you quite honestly what is best for your needs, giving the advantages and disadvantages of each piece of equipment you may have been considering.

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Should you wish confirmation of our findings in this matter, you may refer to Page 35 of the March issue of *High Fidelity Magazine*. Then you will understand why the Service Department of High-Fidelity House checks each unit so carefully, often spend five to six hours on a single order when necessary, and always at no cost to you.

3. Have you ever bought high fidelity equipment and realized almost instantly that it wasn’t what you wanted? High-Fidelity House *unconditionally* guarantees complete satisfaction or a full *cash* refund.

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Would you like to know more about High-Fidelity House? Would you like to obtain some valuable information which will save you money and perhaps protect you from costly mistakes? No matter where you buy your audio components, you will benefit from the information contained in our Bulletin G—over 5000 words, covering many topics which have never before been discussed in print. Yet this valuable bulletin is absolutely free. We’ll be glad to send you a copy if you will write your name and address on an ordinary postal card.

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P.S. Recently other dealers and distributors have noticed our success, and have tried to copy our advertising. Some of them have even tried to copy our name!! Don’t be fooled, High-Fidelity House has *no branches anywhere*. Our showroom, warehouse, and mail-order department are all located here in Pasadena. If you find other dealers whose advertisements seem similar to ours, reflect on the fact that words are cheap. Anyone can claim to offer the same services that High-Fidelity House provides, but if there is another dealer or distributor in the United States who even approaches our standards, we have yet to hear of it.

In the last analysis we refer you once more to our thousands of satisfied customers. There are probably some in your own state, and possibly even in your home town. Many of them are listed in Bulletin G. They will be glad to have you contact them. Our satisfied customers are *proof* that High-Fidelity House is the best place to buy audio equipment, and that we live up to all our promises.

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Tips for the Woodcrafter

by George Bowe

The Basic Shop Tools

Recently I was one of a crowd watching a fascinating demonstration at a local "do-it-yourself" show. The demonstrator was showing the great versatility of a home workshop that combines seven power tools in a single unit—saw, drill press, lathe, sander, jointer, jig saw, and horizontal drill. As the man behind the machine went into his pitch on the merits of his product, the chap in front of me turned to his wife and said, "Now, if I had something like *that*, I could make all those things you want for the house."

This was not a new story—I had heard it many times. In some cases I am sure the men were sincere in the belief that such a wonderful machine is an absolute necessity for home woodworking problems. Others, I rather suspect, used the price of such equipment to dissuade the "better half" from constant pressure to do those little jobs around the house.

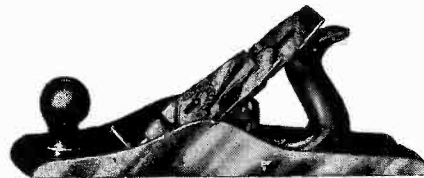
I believe heartily in power tools. They are labor and time-savers with the precision built in. But the belief that an amateur craftsman cannot produce good workmanship without a shopful of power equipment is erroneous. The novice who first learns to work with the basic hand tools will later become a more skilled master of mechanized equipment. Simple cabinetwork, including many types of hi-fi enclosures, can be done very effectively by the amateur craftsman with good hand tools and the ability to follow a good working plan. I can hear a voice already saying, "You don't mean me, bud. The only nail I could ever hit is attached to my finger!" I know just what he means—I've done it myself many times. Fortunately, the frequency of damage lessens with experience. There is nothing mysterious about working with wood. It is basically a question of careful planning, accurate marking and cutting of the individual pieces, and then fitting them together with care to complete the project. Wood is a most gratifying material with which to work. It is yours to shape, assemble, and finish to give you lasting beauty, strength, and acoustical value—a product of your very own craftsmanship.

For the man who still doubts his potential ability in simple wood cabinetry, let me tell the story of the desk upon which sits my old faithful typewriter. In

the midst of the depression some twenty years ago, I needed a desk which my purse would not allow. In one of the "home" magazines a photograph of a desk attracted my attention and, with totally unskilled eye, I translated the picture into a crude working drawing of the various elevations—front, back, top, side, etc. Dimensions were determined by examination of a standard office desk. A visit to the lumber yard provided the necessary materials but when I returned home the real problem arose. Where would the construction take place? From where would the sawing and hammering send forth their busy—but loud—tones? I was living in an apartment house where even normal level on the radio speaker brought comments from the neighbors. By scheduling the noisy operations during daylight hours and the quieter tasks later, I managed to finish the job without threat of eviction. So, apartment dwellers, take heart if you plan a bit of hi-fi construction. There might even be a spot in the basement where some of the heavier work could be completed.

The desk was my first attempt at cabinetry. It's not the finest piece of cabinet-work—neither is it the worst. But it *is* substantial proof that a beginner can do an adequate job with a minimum of tools and without benefit of a workshop. The old desk is still giving top service after twenty years and has been copied several times by other craftsmen.

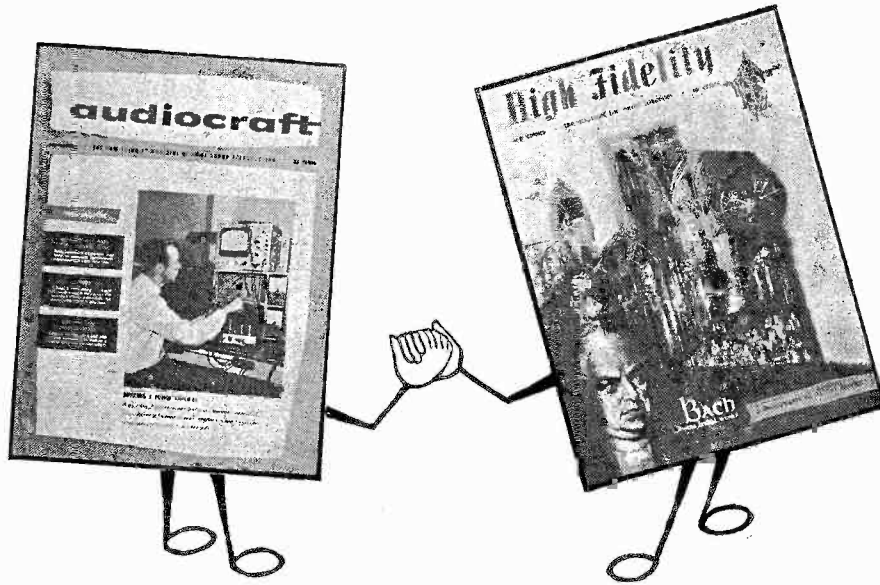
I learned at an early stage that with tools, as with hi-fi components, there is no compromise with quality. An experi-



Millers Falls jack plane.

enced craftsman will always select good tools. A beginner will be wise to do the same, since much of the quality of craftsmanship is embodied in the tool. Good tools, properly cared for, will give years of use and pay a rich reward in the things you create. Since this discussion concerns hand tools, let's compose a list of basic tools essential to construct average speaker and equipment enclosures in-

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It's cake-cuttin' time here at The Publishing House. We've just opened our arms to welcome the newest member of our family—AUDIOCRAFT—the new smoothie of a High Fidelity magazine you're reading right now.

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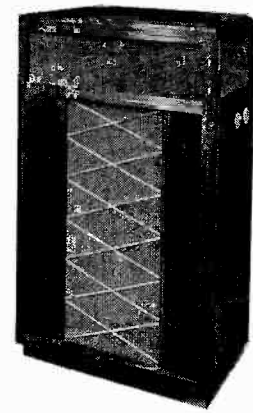
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BUILDING THE Jensen Imperial

by Karl Kramer*



THE Jensen Imperial 3-way Reproducer, illustrated above, has now been commercially available for more than a year. Its advent has created a great deal of interest among music lovers and audiophiles alike. As a result, there has been a demand for the folded-horn enclosure constructional plans; such plans have been distributed widely.

However, it is now recognized that such a system must use special design-co-ordinated speaker units for full realization of the potential performance. Accordingly a complete kit of all these special units is now available, along with the required mounting brackets, connecting cables, and other accessories, so that

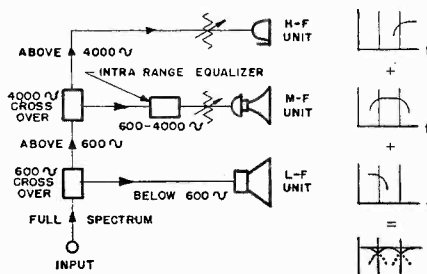


Fig. 1. Diagram of driver connections.

a loudspeaker system fully equivalent to the commercial reproducer can now be assembled by the home constructor. The accompanying material describes this new Jensen kit, gives details for installing the units, and includes a more elaborate description of the unique folded horn enclosure than has been previously available.

The Imperial is a 3-way loudspeaker system using a back-loading folded horn enclosure designed for either corner or sidewall use. Three separate unique loudspeaker units, carefully co-ordinated with each other and the folded horn enclosure, reproduce the full music spectrum. Dividing networks split the spectrum three ways and provide for reproduction of each part by the unit designed expressly for that tonal range. Level controls permit accurate adjust-

ment of tonal balance for any location.

Fig. 1 is a block diagram of the electrical circuit for the Imperial system. What no circuit can show, however, is the intrinsic reproducing quality of the various units and the careful background of design engineering that must be brought to bear in eliminating all coloration in music reproduction. Special mounting brackets provide not only facility of installation, but also control of such elusive factors as diffraction effects. The Jensen Model KT-31 Imperial 3-way Loudspeaker Kit is illustrated in Fig. 2, and a parts list follows:

KT-31 Kit Parts List

Quan.	Part No.	Description
1	P15-LL	Special 15-inch L-F driver
1	M-1222	M-F/H-F assembly
1	A-61	600-cycle crossover network
1	A-402	4,000-cycle crossover network
1	M-1131	Intrange equalizer
2	720101	M-F/H-F balance control
1	M-1228	Balance control accessory kit
1	320102	L bracket
1	5460	Input terminal strip & cable
1	8-in.	Equalizer cable
1	A470211	L-F cable
1	A470210	H-F cable
2		Splice nuts

Building the Cabinet

First study the construction drawing on the opposite page. The pull-apart drawing shows at a glance how the various parts go together. An important point to remember in building your cabinet is that all joints must be accurately fitted and that it must be made as rigid as possible to render the best sound from your hi-fi system. Except for such parts as the base, posts, cleats, and stiffening members, $\frac{3}{4}$ -inch plywood is used throughout. All joints should be adequately glued and, if not screwed, nailed securely with $2\frac{1}{2}$ -inch finishing nails.

Begin by cutting out the bottom for the cabinet. The top and side view drawings give the dimensions to follow in laying it out. You'll note that the bottom of the cabinet is $\frac{3}{4}$ in. smaller all around than the top, so as to let the sides of the cabinet overlap the edges of the bottom. As with all parts, it is important that the bottom be cut squarely, since it must fit the sides and front tightly. Next, cut the front panel for the cabinet. This measures $32\frac{1}{2}$ in. wide and $41\frac{1}{4}$ in. high. As indicated in the top view drawing, the front overlaps the edges of the sides. The $1\frac{3}{4}$ -inch speaker opening is centered in the front panel and on a line $11\frac{3}{4}$ in. up from the bottom. Use a compass and keyhole saw to cut the speaker opening.

Each front corner of the cabinet has a $1\frac{1}{2}$ -inch square post $48\frac{1}{2}$ in. long. Detail A shows how each post is grooved

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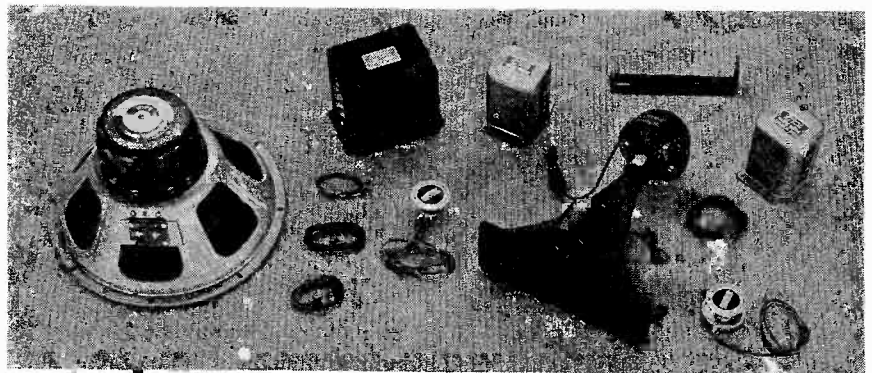
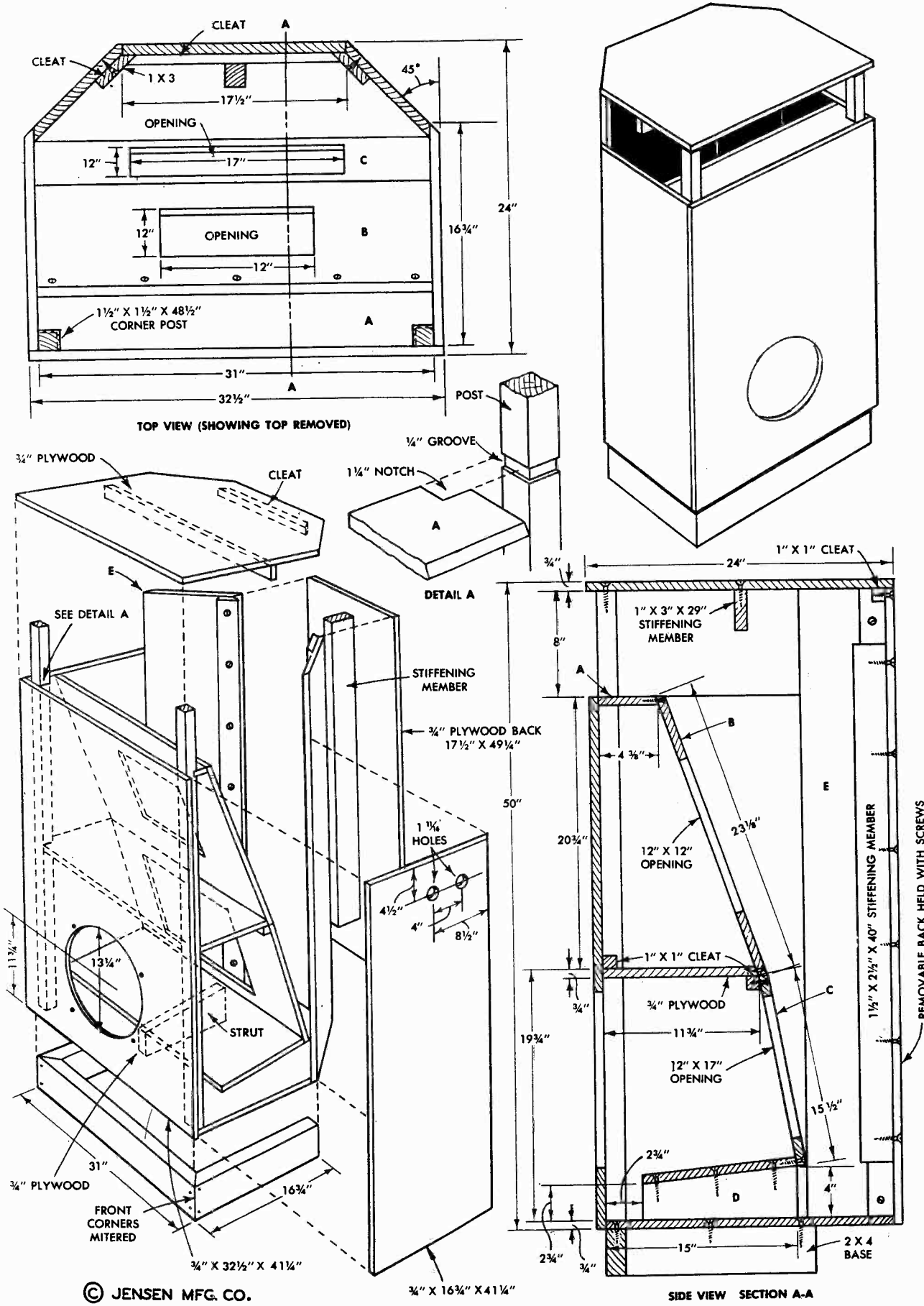


Fig. 2. Components in the parts kit include drivers, treble horns, crossover networks.

*Jensen Manufacturing Company, Chicago, Illinois.
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Material used in this article will appear in a manual to be published by Jensen this fall.



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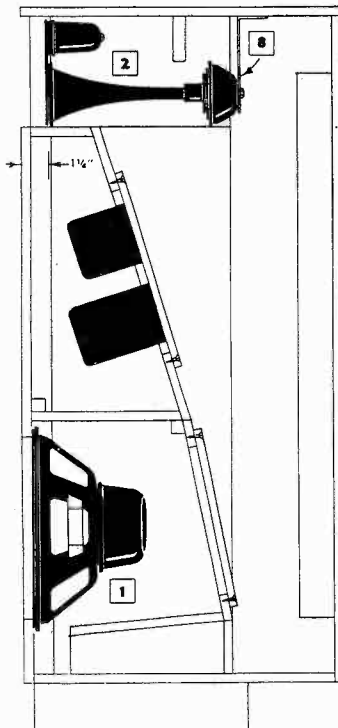
on two faces to receive the notched ends of part A. The grooves are cut $\frac{1}{4}$ in. deep and $\frac{3}{4}$ in. wide at a point 8 in. down from the top of the post. These are easily cut by machine with a dado head or by hand with a saw and chisel.

The bottom and front of the cabinet now can be joined together, using glue and screws or nails. See that the bottom sets in $\frac{3}{4}$ in. on each side and is flush with the bottom edge of the front panel. This joint should fit tightly at all points. Brace the two parts temporarily to hold them at right angles. Like the bottom, each post is placed $\frac{3}{4}$ in. in at the corners and is fastened to the front panel with flat-headed wood screws from the inside. This should bring the grooves in the posts even with the top edge of the front panel.

Part A is made next. This is $4\frac{3}{8}$ in. wide and 31 in. long, and has a $1\frac{1}{4}$ -inch notch at each front corner to enter the grooves in the posts for a distance of $\frac{1}{4}$ in. The rear edge of part A is beveled approximately 20 degrees. Now apply glue to the grooves in both posts and along the front edge of the piece; fit in place. The joint across the front should fit tightly, as the others. Screws can be used to draw it up tight.

Network and speaker compartments are installed next. The center shelf is made $11\frac{3}{4}$ in. wide and 31 in. long. The rear edge is beveled 20° to match the beveled edge of part A, and the two front corners are notched to fit around the $1\frac{1}{2}$ -inch posts. Part B measures $23\frac{1}{8}$ in. long and 31 in. wide, and has a 12-inch square opening cut in the

Fig. 3. How parts are placed.



center. Both top and bottom edges of the piece are beveled as shown.

Now lay the cabinet assembly face down. The notched center shelf is attached to the front panel with a 1-inch square cleat that is cut to fit between the posts, then glued and screwed at a point $20\frac{3}{4}$ in. down from the front-panel top. The shelf is glued and screwed in turn to the cleat and posts, after which part B is glued and screwed to the beveled edges of part A and the shelf. At this point it is best to add a side to the cabinet to give support to the bottom. Each side measures the same, $16\frac{3}{4}$ by $41\frac{1}{4}$ in., and is beveled 45° along the rear edge to be even with part E. (See top view). Note in the case of the right-hand side that two holes are bored in it near the top for the H-F and M-F balance controls. Glue is applied to all edges that the side panel will touch, and screws or finishing nails are used to fasten it securely.

The lower speaker compartment is added next. Looking at the sectional view you can see that the lower shelf, which is $12\frac{5}{16}$ in. wide and 31 in. long, is held at a slant by center support D. This part is 4 in. high at the rear and $2\frac{3}{4}$ in. high at the front, and is glued and screwed to the bottom of the cabinet $2\frac{3}{4}$ in. back from the front panel. The shelf in turn is butted against the side of the cabinet and screwed to the top of the support. A slight bevel is necessary (approximately 6°) at the back edge. Nails are driven through the side panel and into the end of the shelf. The speaker compartment is enclosed with a $15\frac{1}{2}$ by 31-inch panel, part C, which has a 12 by 17-inch access opening cut in the center. The lower edge is glued and screwed to the rear edge of the shelf, while the upper edge is fastened to a 1-inch (approximately 12°) beveled cleat which is first glued and screwed to the underside of the center shelf. With part C in place, turn the cabinet on its side and install the other side panel, first applying glue to all contacting surfaces.

Both sides of the cabinet can be completed now by adding the full length panels, parts E. Note in the top view that both vertical edges of these panels are beveled 45° and that rabbets for the removable back are formed with 1 by 3-inch cleats. Like the sides, these panels overlap the edges of the bottom.

The top of the cabinet is of the same shape as the bottom except $\frac{3}{4}$ in. larger all around. A stiffening member is added to the underside of the top to increase rigidity and reduce vibration. The top is supported by the posts and parts E, to which it is fastened with glue and finishing nails. This leaves the removable back of the cabinet which is held with screws. It too is fitted with a stiffening cleat, running down the center. Finally, a 1-inch square cleat is fitted across the opening at the top to provide

a screwing surface for the removable back panel. The 2 by 4-inch base is optional although it does improve the looks of the cabinet. This may be added at a time of construction when it is con-

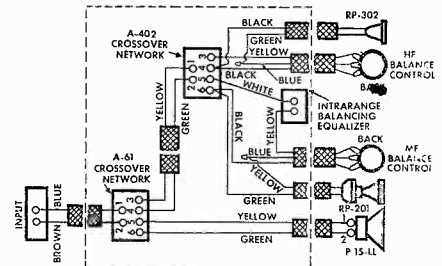


Fig. 4. Wiring diagram for the Imperial.

venient to drive screws down through the bottom. Screws in counterbored holes in the base may alternatively be used to attach it. While not shown in the sectional view, the access openings to the speaker and network compartments are covered with $\frac{3}{4}$ -inch plywood doors which are held with screws. All nail and screw heads can be sunk slightly below the surface and puttied over.

Cabinet Materials List

	3/4-inch Plywood	
1	22 1/2 by 31	Bottom
1	24 by 32 1/2	Top
1	32 1/2 by 41 1/4	Front
1	17 1/2 by 49 1/4	Back
1	4 3/8 by 31	Part A
2	11 3/8 by 49 1/4	Part E
2	16 3/4 by 41 1/4	Sides
1	11 3/4 by 31	Center Shelf
1	12 5/16 by 31	Lower Shelf
1	23 1/8 by 31	Part B
1	15 1/2 by 31	Part C
1	4 by 12 1/4	Part D
	Lumber	
1	3/4 by 2 3/8 by 29	Top Stiffener
1	1 1/2 by 2 1/2 by 40	Back Stiffener
1	1 3/8 by 3 3/8 by 64 1/2	Base
2	3/4 by 2 3/8 by 48 1/2	Cleats
1	1 by 1 by 76 1/2	Cleat
2	1 1/2 by 1 1/2 by 48 1/2	Posts

All dimensions in inches

Installing the Speaker Units

Fig. 3 shows placement of the speaker units in the folded-horn cabinet. Lay the cabinet on its face, and install the P15-LL low-frequency driver unit with terminal screws up by means of 8 No. 10 by 1-inch long round-head wood screws, tightening carefully to prevent distortion of the speaker frame. Drill a small hole near the center of the center shelf and pass the L-F cable through the hole. Connect this cable to the terminals according to the color-coded wiring diagram, Fig. 4, pulling the excess cable up into the upper or network compartment. Attach the cover of the woofer compartment securely with wood screws on approximately 6-in. centers. Caulk the cable hole with a felt strip so that this speaker chamber is air-tight.

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That Professional Look

by Joseph Marshall

What you value in your wife are her inner virtues, but you still like to see her well-dressed, don't you? Why not apply the same thinking to your audio rig, especially since it's inexpensive and rather easy?

PROBABLY the biggest problem faced by the man who rolls his own radio and high fidelity gear is that of making the product look worthy of the time and money expended on it. Many a home-built amplifier, instrument, or receiver is beautiful to see under the chassis. Unfortunately, the wife and friends see only the outer face, usually the panel, and make their judgments of craftsmanship largely on the basis of its superficial appearance. And — equally unfortunately — most of us, however adept with the pliers and soldering iron, fall down on the job of providing that final finish which pleases the eye. There was a time when there was some excuse for this, but today the means of achieving that professional look, or something satisfyingly close to it, are on the counter or in the catalogue of almost every radio parts distributor. Moreover, it takes very little practice or skill to become sufficiently adept at employing them to avoid the need to apologize for the appearance of otherwise fine equipment.

There are, needless to say, several aspects to the beautification of an installation, and it is astute to keep them *all* in mind even when dealing with only one of them. Otherwise it is possible to find that the rosy-sheened finish you have labored long and wearily to impart to your cabinet clashes impossibly with the only grille-cloth you can find that is not garish and still does not muffle your highs. We are going to deal only with the front of the front end — control panels. There are few hazards here, if you are conservative. But you must pick an escutcheon-hue, and knobs. So remember that maroon is not likely to get along well with korina, or brass knobs with silver driftwood.

Finishing the Panel

Whether the equipment is contained in a metal cabinet (of which there is now a wide enough variety to suit any purpose or taste) or, as in the case of most hi-fi gear, it is placed within some sort

of furniture-cabinet which conceals the chassis, the problem is to provide some sort of escutcheon or marking on the face of the cabinet, not only for decoration but for convenience in operating the equipment and accuracy in making adjustments. There are two ways to treat the wood cabinet problem. One is to cut in the face of the cabinet a suitable number of holes to accommodate the shafts of the controls, and then letter the surface of the wood itself.

On the other hand, commercial high fidelity gear usually comes with an escutcheon of metal or plastic already lettered and marked. This simplifies matters greatly. For one thing, the escutcheon makes the drilling of the cabinet much less critical. In most cases, instead of trying to drill accurately placed, individual holes, it is possible to saw out a rough slot. The escutcheon hides the slot and presents a fine finished face. This is so excellent an idea that it is well worth imitating in home made equipments, particularly since it simplifies rather than complicates the problem of putting a good face on a good job and also offers greater scope for individual taste and preference.

A suitable escutcheon for just about any equipment can be made from aluminum chassis bottom plates. The 3 by 17-inch size (which is actually 4 by 17) is the most useful, but the material is easily cut to any dimension and other standard bottom plates can be used when larger or smaller escutcheons are needed. Most of these bottom plates have raised bosses on the corners which are not desirable for panel escutcheon use. It will be necessary to cut off about an inch from each end; keep this in mind when choosing the size. Some distributors have plain aluminum sheets in thicknesses from 1/32 in. up; such sheets may also be obtained at many sheet-metal shops. The 1/16-inch thickness is excellent.

The first job is to provide a handsome surface — fortunately, this is now the

easiest of all problems to solve. Even if you've had no experience in using paint, you can obtain a thoroughly professional painted finish in just about any conceivable color with the aerosol-type paint sprays. A number of manufacturers now offer these in a wide variety of enamels, glossy and dull; in metallic colors; and even in wrinkle-type paint. A can holding about a half-pint (which is enough for dozens of panels) costs from \$1.25 to \$1.50. These are quite easy to apply, and surprisingly different effects can be achieved by varying the method of application.

For escutcheons, panels, and instrument cases I suggest you disregard the instructions on the can, and anything you may know about paint spraying, and use instead the unorthodox procedure detailed below. This will result in a quite handsome semi-dull, semi-ripple finish which rather resembles hammertone and not only requires no skill but actually capitalizes on lack of skill. The process involves deliberate "orange-peeling". This is a name for a serious defect in automobile finish which produces a rough, rippled surface resembling the surface of an orange. Although no one wants an orange-peel finish on a car, it produces a handsome and very commercial appearance on audio escutcheons and radio panels.

Orange-peel can be achieved easily with the aerosol spray paints by using this procedure: 1) be sure the surface of the panel is thoroughly clean; use cleaning fluid, lacquer thinner, or nail polish remover to clean it. (It should be drilled before painting, of course.) 2) Lay the panel on a sheet of paper larger by a foot or so all around. 3) Spray from an angle between 125 and 180° instead of the usual 90°. 4) Hold the spray head or can quite close to the panel, 8 to 10 in. 5) Spray heavily and let the paint build up into a heavy coat. If the gun spatters the paint in large droplets rather than a fine mist, so much the better. You will note that the force of the spray puts

fine wind ripples in the film of paint; encourage this. 6) As soon as possible after spraying, preferably within 5 minutes, place the panel in an oven which has been preheated to about 225° and let it bake for 15 to 30 minutes, depending on the nature of the paint, or until it is thoroughly set and dried. The baking is necessary to prevent the rippled paint from flowing into a smooth finish. After taking it out of the oven, let the panel cure for some hours, preferably overnight. You will have a thick semi-matte, semi-glazed finish. The method is especially recommended when using glossy enamels which, applied normally, produce a finish on which fingerprints and any errors made in spraying or subsequently applied lettering show up embarrassingly.

Lettering

A good part of that commercial look comes from a neat job of lettering and dial marking. This is easier to achieve today than ever before because better decals in wide variety are now available. Experience, however, is needed to do a good job. I strongly recommend that before undertaking to letter a finished panel you do some experimenting and practicing. This is no trouble and involves no extra expense, since most decal kits have a great many excess decals and

terrible job and ruin a whole day's work, as I have discovered the hard way.

Follow the instructions carefully and literally. The new decals are very fast. A few seconds of immersion and perhaps a half-minute of lying in place on the panel are enough to loosen the film from the paper. Do not oversoak; the letters may separate and assembling them is a tedious process. The various sets have just about every conceivable legend one might want. If, however, you do not find a legend you need it is no great trick to assemble one, letter by letter, using portions of unused and unwanted decals. One tip: trim the decals as close to the lettering or dial markings as you can, so as to minimize the amount of lacquer which has to be disposed of later.

The nasty part of working with decals is doing something with the lacquer film which surrounds the lettering or dial markings and gives them a dirty glazed appearance. There are two ways of dealing with it. One is to take a fine camel's hair brush (the 1/8 or 1/4-inch size is good), dip it in lacquer solvent or clear nail polish remover, squeeze it against the edge of the bottle thoroughly so that it is barely moist, and *carefully* brush around and over the lettering. This does not actually remove the film; it merely dilutes it, spreads it and makes the edges more indeterminate, so that the film is

simpler to use but not so precise in marking nor so versatile are the dial decals just introduced in the Hi-Fi Knob Kit by Waldon Electronics. The kit contains 10 decals labeled with the commonest legends employed in hi-fi equipment. These decals are circles of silver with lettering in black. Because the silver circle is opaque and the lacquer extends just a fraction beyond the edges, the lacquer film presents no problem at all; indeed, the small amount which overlaps the silver disk produces a rather handsome two-tone effect. Because these decals are somewhat thicker, a little more care is needed in smoothing the decals down to obtain bubble-free adhesion. Be sure the surface of the panel is very clean and free of any grease: make certain of this by cleaning it with cleaning fluid before applying the decals. When the decal is slipped off the paper, smooth it down softly with your fingers, working from the middle out, to push out the air bubbles. Now absorb the water with a blotter or a paper tissue, and then smooth down again with a soft cloth or a paper tissue. Fig. 2 is a reproduction of an escutcheon made with the Waldon decals on an aluminum sheet painted as described previously.

Both the Waldon and Techni-Label decals are applicable to wood surfaces also. If they are applied to a wood surface which is already finished, the procedure is the same as detailed above for metal panels. Start, however, by removing any wax or grease on the wood with cleaning fluid. Greater care is necessary when dealing with the lacquer film. Lacquer thinner is a potent solvent (that's why it is used for this purpose); it will quickly remove a varnish or lacquer finish on wood. The brush should be scarcely moistened and applied with delicate care. Properly done, the lacquer film will be amalgamated into the top layer of varnish on the wood surface. If the wood panel is unfinished, I suggest this procedure: 1) stain the panel and apply the first coat of varnish. When this is thoroughly dry, 2) apply the decals and reduce the lacquer film. 3) Spray or brush the entire panel with clear lacquer, plastic spray, or varnish. This will produce the final finish.

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Plexiglas Panels, Escutcheons

Some recent commercial hi-fi equipment has been produced with Plexiglas escutcheons. After some experimenting and co-operation from the makers of Plexiglas and Techni-Labels, I have developed a

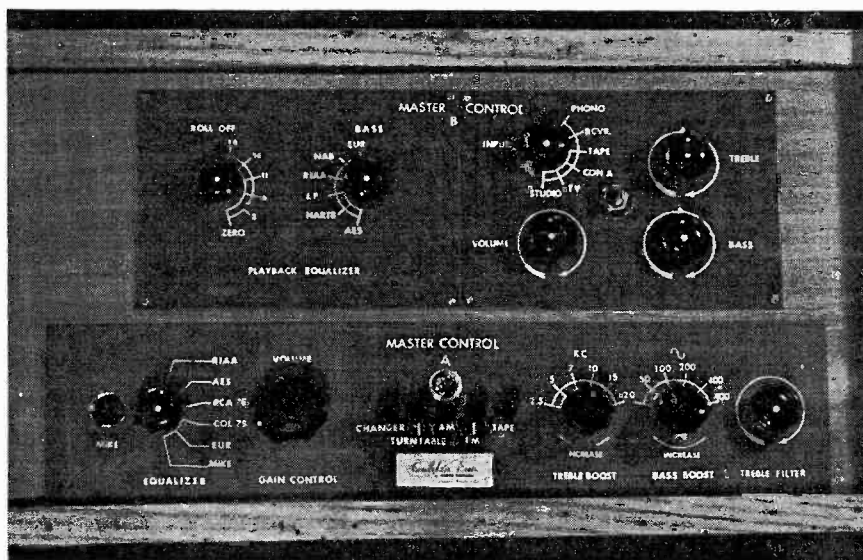


Fig. 1. Home-crafted escutcheon's Techni-Label decals are glossed by a lacquer spray.

a few can be expended in practice without disadvantage.

The widest variety of lettering is furnished in the Techni-Labels series of panel decals. They are available at almost every electronics parts store. The latest types are easy to apply properly, but be sure you get a set that is reasonably fresh and do not attempt to use any decals which may have been on the shelf for a year or two. The materials used are partly organic and deteriorate rapidly with excess heat, humidity, or dryness; a set in poor condition may result in a

not as noticeable as it was to begin with. Great care is necessary; excess lacquer thinner or excessive brushing may shrivel up the lettering or even remove it entirely. This is the part that requires the practice.

The other method is simpler. Just spray the panel with a light coat of clear lacquer. This does not have so much effect on the lacquer film itself, but it puts a film over the entire surface. The contrast is lessened and, therefore, the appearance is improved. Either method will fix the decals firmly. The instruc-

method of applying decals to this material and achieving some elegant effects quite easily. Fig. 3 shows one of these experimental escutcheons over a walnut panel.

Plexiglas is readily available in most cities either from dealers in plastic materials (see the Yellow Book under Plastics or Plexiglas) or from some hobby shops. It comes in various thicknesses, of which the most appropriate for panel escutcheons are $\frac{1}{8}$ and $\frac{1}{4}$ -inch. The

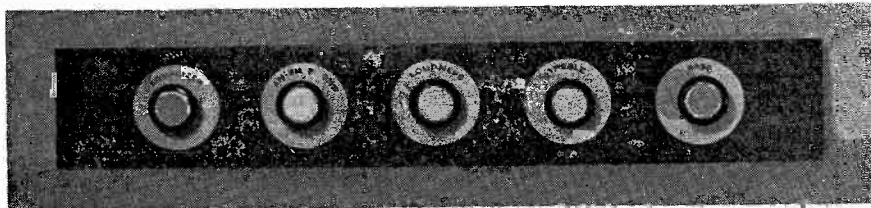


Fig. 2. Waldon disk-decals are slightly, easy to apply and satisfy most panel needs.

former costs about \$1.50 per square foot; the latter, about \$2.50.

The material is easy to work with. It can be cut with a power jig saw, or with a hand hack saw or coping saw. When using power tools, especially a jig saw, do not attempt to force the cutting too fast. Bevelled edges, which catch the light like cut glass, produce an especially handsome effect for escutcheons. If you have a disc sander, especially if it has a table which can be set at various angles, the bevelling is easily achieved. If you have no power tools but are clever with a file, you can file the edges to a bevel. Do not smooth the rough finish produced by sandpaper or file; the roughness is what gives the effect. Plexiglas is easily drilled also. Small holes are no problem at all; holes larger than $\frac{1}{4}$ in. require some care to avoid chipping as the drill breaks through the final surface. It is well to experiment on a small piece before undertaking to drill an entire panel.

Decals can be applied to the outside surface of the Plexiglas as on wood or metal panels. However, a much better effect is produced if they are applied to the reverse side. First, it is easier to deal with the lacquer film. Second, the appearance is far more handsome: when viewed at an angle it resembles that of cut or engraved glass. Applying decals to the rear, however, requires some practice and an entirely different technique.

The first problem is that conventional decals have no adhesive on the front surface, which is the one that must be applied in this instance. There are 2 ways of providing adhesion. If the escutcheon is not too large and there aren't too many decals to be applied, so that the entire job can be completed in about 10 minutes, the following procedure is recommended:

1) Clean the rear surface of the Plexiglas thoroughly with water and detergent; wipe dry with a chamois if you have one. 2) Have all the desired decals

cut out and at hand for immediate placement. 3) Spray the rear side of the Plexiglas with clear lacquer or acrylic liquid plastic. 4) Let this film dry just enough to become tacky. 5) Apply the decals *dry*, paper and all, watching the placement carefully through the front of the Plexiglas. Try to place the decal precisely to begin with. Although it can be moved slightly on the tacky lacquer, there is danger of damage to the lettering, and it is best to avoid smearing it

around. 6) Once it is located, press the decal firmly with the fingers to obtain uniform and wrinkle-free adhesion. 7) If you like, you can place a flat piece of metal sheeting or a pane of glass over the paper on the decals and weight it down with books or whatever. In any case, 8) let the decals set overnight. This is absolutely essential with this method. 9) The next day, dip the entire escutcheon in clean water for about 10 seconds. After taking out of the water, use a brush on the back of the paper to make sure that every part of the paper is thoroughly soaked. 10) Slide the paper backing off the decals. You will very likely find that when this is done there is a gummy, milky film over the decals. 11) The film is water-soluble; remove it either by brushing with a well wetted brush or by immersing the Plexiglas in water and brushing. 12) The lacquer may be particularly scummy looking, very likely worse than it usually is on wood or metal panels. It can be smoothed and worked out with lacquer thinner and brush. In this case the brush can be more moist when dealing with those portions of the film between the markings on dial scales. But be careful not to go over the lettering or scale markings with too wet a brush, for they may shrivel up and possibly come right off. 13) Apply a thin coat of clear lacquer or liquid plastic from a spray bomb over the whole sheet, decals and all.

The second method permits more leisurely work and is less risky, since slight errors can be corrected without affecting the whole panel. It is, however, just a little more tricky to use. Be sure the Plexiglas is clean. Then 1) dip a small brush in lacquer thinner or clear nail polish remover. Work out most of the liquid against the side of the bottle. Quickly but *lightly* brush the lettering or lines on the decal with the brush. It is simpler to do this in the case of strips of letters than with a larger dial marking, but a little dexterity and practice

soon develops the knack. 2) *Immediately* apply the decal to the Plexiglas. Again, it is desirable to place it correctly on the first try. Watch the lettering as the decal is pressed in place. If it starts flowing together, spreading or blurring, you have applied too much thinner. In that case remove the decal, clean the surface of the Plexiglas with a cloth dipped in lacquer thinner, and try again with another decal. From this point on the procedure is the same as with the other method. Weight labels down, let set overnight, remove paper, clean off the milky film, dry carefully. The lacquer film will probably be especially ugly and may have a frosted look because of trapped air bubbles. Careful application of thinner with brush will flow it smooth and once the escutcheon is in place, slight imperfections will be much less evident than is the case on wood or metal.

A great variety of effects is possible with these Plexiglas escutcheons. They are, in my opinion, very handsome when placed directly over wood paneling, or the dark surface of a painted metal panel. However, the back of the Plexiglas can be sprayed (over the decals) with metallic gold, silver, aluminum, or a colored enamel. (Black gives an especially handsome effect). Do the spraying carefully to make the initial film as good as possible.

Interesting effects can be obtained by using fabrics or colored papers, grill cloth, metal foils, or the like between the escutcheon and the panel. Wallpaper, especially Japanese grass paper, parchments, fine colored book papers (end papers or fancy cover stocks), artificial leathers, dress and upholstery fabrics,

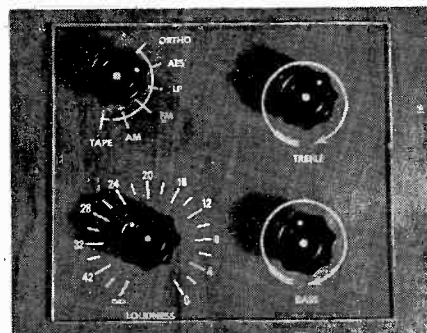


Fig. 3. Decals on Plexiglas over wood.

imitation marble papers, and so on can be used to fit any decor or decorative ideas.

Be careful when handling Plexiglas not to scratch it. Protect it after it is in place by washing with detergent and water, then waxing with a fine grade of automobile wax or glass wax.

If you are a good draftsman and letterer you can, of course, achieve individual effects by hand-drawing the dial calibrations and lettering on some interesting paper, then covering it with a Plexiglas escutcheon.

Out of the SPEAKER

Into the ROOM

Experts agree that the loudspeaker-listening room relationship is important; beyond that, opinions differ. Here is a stimulating (and convincing) presentation of one point of view.

by William C. Bohn

THE least understood and most poorly handled problem in high fidelity today is the acoustical relationship between the loudspeaker system and the listening room. Over the past few years the general lack of awareness of this relationship has become increasingly evident to the author in his high fidelity consulting and installation work.

When one considers the minimum distortion requirements for other elements of a high fidelity system, it is surprising to find that the listening room is frequently permitted to add distortion and introduce radical peaks and nulls in an otherwise smooth audio response curve. For a given passage of music, one spot in such a room will produce a totally different balance between bass and treble than another spot in the same room. You may prove this fact to your own satisfaction by using the below-100-cycle bands on any of the numerous test records now available. An audio oscillator is even better for the purpose, since it can be set to any desired frequency while the experiments are carried out. You will probably find that there are places in a listening room where a 50-cycle tone, for instance, is practically inaudible and other places in the same room where it is strong enough to be uncomfortable.

As an example of an amateur solution to the problem of conflicting room acoustics, one enthusiast actually hung blankets in his listening room. That particular room had an old-fashioned metal ceiling which caused considerable acoustical difficulty. By the addition of the blankets he achieved the musical clarity he knew to be inherent in the system he had purchased. His critical ear was far more developed than he had realized, and thus he was not satisfied to say simply that his high fidelity system didn't sound quite as well as the demonstration system he had heard before buying. He did something about it. He was, however, the exception.

Most high fidelity enthusiasts are satisfied to quote amplifier and preamplifier distortion figures and show the manufacturers' published frequency curves of their pick-up cartridges and loudspeaker systems. They can thereby *prove* that their high fidelity systems are "flat from 20 to nearly 20,000 cycles". This "proof" is seldom borne out by the

judgment of the ears of a musically trained listener. He may hear an annoying peak in the mid-range somewhere around A above middle C on the piano. Or he might notice lack of definition in the strings of the recorded orchestra. Also, he may notice that the bass is patchy, with some of the low notes coming through very strongly and others missing altogether. The source of these difficulties can often be found in an incorrect relationship between the loudspeaker and the associated listening room.

Speaker Orientation

Perhaps you have noticed that most table-model television sets are played louder than their AM radio predecessors. In spite of the fact that television uses FM for its audio channel, the clarity and intelligibility of the TV set is often not as good as the old table-model radio. One reason for this peculiar situation can be found in its construction. The AM table-model radio has a loudspeaker which is directed at the listener, but the table-model TV set has its loudspeaker directed out the top, bottom, or, more usually, one side of the cabinet. The TV listener actually relies more upon reflected sound from a wall or ceiling than upon direct radiation from the speaker itself. There is a conflict between the direct radiated sound waves and the reflected ones. This conflict is caused by the time difference between the two which produces out-of-phase sound and sometimes even noticeable echoes. In order for the designer of a table-model TV set to feature picture size and compactness, he has to compromise on the loudspeaker placement. There is room, therefore, for a good deal of improvement in the audio systems of television sets.

Similarly, the designers of present day table-model phonographs, to satisfy the so-called 3D trend in audio, have had to increase the number of loudspeaker sound sources without cautioning the purchaser about the acoustical difficulties he may encounter. For example, if a table-model phonograph (or tape recorder) having three loudspeakers, one in the front and two side-mounted, is used in a long and narrow room and is aimed down the long dimension, the two side-mounted speakers will face opposite

and fairly close walls. The sound from these two speakers will be reflected directly back by the wall surfaces. Such reflections will almost certainly cause "muddy" audio. The rotation of this particular phonograph as little as ten degrees one way or the other can change the reflections so that they do not cancel or reinforce the direct radiated sound in a distorted manner, but come clearly out into the room. The immediate and very apparent result is a marked decrease in muddiness.

In larger, more elaborate high fidelity music systems the acoustics of the listening room are even more important. And it is here that an argument may occur between the interior decorator and the acoustical engineer. The interior decorator arranges a room to achieve an aesthetic form and color balance. He says, "Here in this corner will be a bookcase, there a table, here a sofa, and over there the hi-fi system next to the club chair." The acoustical engineer replies, "The loudspeaker should best be in the corner away from the listener. It should aim into draperies or soft furniture across a room treated with carpeting and other sound deadening material to cut down echo effects." "But," says the interior decorator, "that corner is already taken by the bookcase." The result of such a discussion is often detrimental to the audio quality of an excellent high fidelity system. Large sums of money are often spent on elaborate custom high fidelity installations with fine equipment which, because of improper location or room treatment, cannot perform to best advantage for their owners. But by knowing what effects on sound various types of room treatment have, you can usually work out a compromise that will produce acceptable sound as well as good appearance.

For the home music listener to enjoy really good bass response, his listening room should be reasonably large. It is no accident that the lowest common pedal note of an organ is produced by a pipe 32 feet long. To reproduce that note in balanced relationship with the rest of the sound spectrum, the home listening room should have an air path of at least half that length from the loudspeaker system, and preferably the full length.

Between the loudspeaker system and the listener there should be a minimum

of furniture. If a piece of furniture must be in the path of the direct radiated sound from the loudspeaker, it should best be a soft, absorbent one such as an easy chair or sofa. Hard, reflective furniture such as a piano or desk should logically be away from the loudspeaker.

Placing a speaker system in a corner of a room will materially increase the effective path length because the room's diagonal is used, and air loading is better, thereby improving the overall bass response. Care should be taken with the installation of a loudspeaker system in a room which is not essentially a rectangle but has alcoves or hallways running from it. An alcove or hallway should not be used for the purpose of "placing the speaker out of the way", as the home decorator might suggest. The reflective acoustics of such an area will conflict badly with the direct radiated sound as it reaches the listener in the main part of the room. And care should also be taken to avoid locating the speaker system too near the ceiling with its usually hard surface and sound reflective characteristics. In an installation where the speaker is giving below-standard performance, it is worthwhile trying different locations while the system is reproducing a good musical source.

Room Treatment

The high frequency end of the audible sound spectrum reflects noticeably from hard surfaces and is quite easily absorbed by deadening materials. It is the low frequency range which is often distorted by both the loudspeaker system and room acoustics. Reflections in the high frequencies are easily noticed by the ear, but lower frequency reflections can produce some very annoying effects, the most obvious of which is cancellation and reinforcement of certain low tones at different places in the room. With experience it often is possible to judge a room's acoustical properties simply by talking in it. But for more accuracy and with less experience it is better to use some of the simpler, proven tools of the acoustical engineer. A sharp hand-clap will give a good indication of reflections in a given room. The frequencies in a strong hand clap are many, usually in the range above 400 cycles. If two opposite walls of a room are parallel and reflective, an actual ringing tone will occur. When a loudspeaker is placed within the path of that ringing, and it is made to produce the same note, an obvious resonance is produced. If one were compelled for aesthetic reasons to use that space for a speaker system, it would be wise to put sound-absorbent acoustical tile or heavy draperies on one or both surfaces to cut down the reflection and ringing. The result would not be as good as relocating the speaker, but it certainly would be considerably better than with no absorbent material.

Some rooms have hard, polished floors without carpeting. A high fidelity installation was made by the author in one such room; the client did not want to change the appearance of the floor, which was a polished and attractive parquet. Still, he wanted the best possible sound. The bright drapery and upholstery in the room were acoustically inadequate. As a solution, to produce almost the same effect as carpeting on the floor, acoustical tile was used on the ceiling. Another example of an acoustical problem to be solved is a room with considerable window area. Glass is an effective reflector of sound, and a room with many windows such as a solarium will be a poor high fidelity listening room unless it is treated acoustically. Hanging drapery is the most attractive method to improve musical sound in a room of that sort. It may be necessary also to use acoustical tile on the ceiling or heavy carpeting on the floor before such a room is really satisfactory for critical listening.

By using two separate loudspeaker systems located in different corners of a room it is often possible to smooth out the erratic frequency/intensity level curve of a sound as it actually occurs in a particular room. But the speaker systems must be of equally high quality to be satisfactory—not one separate little auxiliary speaker working against a top quality loudspeaker system. They should, in short, be a "matched pair". The result of a matched pair idea is invariably impressive sound, but it is very expensive. Incidentally, the phasing of such a matched pair should be taken into account, but the two need not necessarily be in phase. Trial and error methods should be used for best quality sound.

Perhaps at this point we should state a definition: the purpose of high fidelity listening in the home is to approach, through the use of high fidelity recordings made in the best concert halls of the world, duplication of the experience of a member of the audience in each of these halls. The listening room should, therefore, have as little acoustical character of its own as possible, in order not to detract from the acoustics of the source. A fairly "sound proofed" room will satisfy this requirement. Acoustical absorption prevents superimposing the acoustics of the source upon those of the listening room. Such superimposition of acoustics can be the cause of poorly defined sound. To achieve the previously stated purpose of high fidelity listening you should, in fact, hear only the enhancement of the music as produced by the acoustics of the original concert hall.

Loudspeaker Differences

We should now consider the essential differences between the sounds produced by the different loudspeakers. The easiest group to handle acoustically consists of

loudspeakers which have a rather mellow quality favoring the middle and bass registers rather than the higher frequencies. These systems need the least amount of acoustical absorption in a listening room. Direct radiators and several coaxial types fall into the mellow sound category. They are also inclined to have less intermodulation distortion than the so-called "brilliant" types which include triaxial and some of the coaxial loudspeakers. A brilliant-sounding speaker system needs the most careful handling acoustically to achieve good musical balance. One rule in acoustics is all too frequently ignored: the use of the proper enclosure design is a basic condition for good musical balance in a loudspeaker system. Unfortunately, most high fidelity loudspeakers are marketed without enclosures. The purchaser is given one more chance for error by allowing him to try to choose the proper enclosure. He is usually not qualified except, perhaps, aesthetically, when he says he likes the looks of a given enclosure design. In spite of advertisers' claims, the "revolutionary new enclosures" X or Y will *not* improve the sound of *any* good loudspeaker. Not every loudspeaker will acoustically "fit" every enclosure. But, what is far worse, many enclosures are totally unsatisfactory acoustically for certain loudspeakers. A good loudspeaker should be mounted in the enclosure specifically designed for it.

Better loudspeaker designs deserve more careful acoustical handling, since they are capable of approaching more closely the goal of perfection in audio. The popularity of the corner enclosure has developed not only because the apparent size of the source is increased by using the corner of a room, but also because the sound has less chance for direct reflection back into the loudspeaker. There are fewer non-linear peaks and nulls if the loudspeaker is placed in a corner. Standing waves caused by reflection within an enclosure, in addition to those within the room, are greatly lessened by the use of the triangular enclosure design.

It is the opinion of this author that much more emphasis will be put on the proper acoustical handling of high fidelity systems in the future. The pattern may follow the example set by the record industry which, in order to compete with high quality musical engineering from Europe, has been steadily improving the acoustical balances in its commercial recordings. More and more people are becoming aware of the potentialities hidden in some of these recordings and are striving to reproduce the musical nuances in their homes. An understanding of the relationship between room acoustics and loudspeaker systems will help the high fidelity enthusiast immeasurably in achieving better-quality music in his own listening room.

You Can Build A POWER AMPLIFIER

by Frank R. Wright

ONE of the most rewarding audio construction projects that can be undertaken is that of building a power amplifier. Yet, surprisingly, it is one of the easiest—it doesn't involve the vigorous physical exertion required in woodworking, and is not so complex nor demanding of so high a degree of manual dexterity as, say, the assembly and wiring of a preamplifier-control unit. It may well be the ideal first enterprise of the aspiring sound craftsman, giving him a justifiable glow of accomplishment as well as increasing his experience with the needle-nose pliers and soldering iron. And not to be ignored by anyone, neophyte or not, is the saving* often possible in building his own audio gear—and the satisfaction in being able to say (modestly, of course), "Why, yes, I made it!"

There are four methods by which you can proceed to build your own power amplifier. First, you can buy a complete kit containing all parts, nuts and bolts, a punched chassis, wire, and detailed step-by-step assembly and wiring instructions with pictorial diagrams. These are available from Heath Company and Techmaster (in the latter, wire is omitted but some parts are mounted on the chassis). Variations of complete kits are

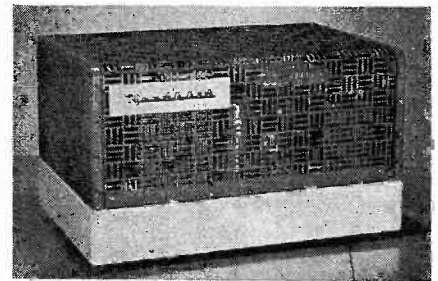
*A saving in money only, let us hasten to point out. If you assign a reasonable value to the time you'll consume in such a project and add it to the cost of parts, you'll probably come up with a figure higher than that of a comparable commercial product. From a strictly economic point of view, then, you won't save anything unless the time you allocate to the job is hobby time anyway.

also marketed by Knight (Allied Radio), UTC, Triad, and Stancor, among others. This method is heartily recommended for beginners and for those who want to accomplish the job with a minimum of fuss and time expenditure. UTC markets also a "kit" that is essentially a completely-assembled and wired amplifier; all you do to finish it is make a dozen screw-terminal connections. You don't even need a soldering iron—but the money saved, like the work required, is negligible.

The second approach is to buy a package from one of the transformer manufacturers that includes the output transformer and usually the power transformer and filter choke, with or without a punched chassis. An instruction book, or at least a schematic diagram with recommended parts, is furnished; it is up to you to obtain the resistors, condensers, wire, and hardware, and to wire the amplifier without benefit (usually) of a pictorial diagram.

A third method is to choose a circuit from the thousands published in magazines and books. Often you can find one with special features that appeal to you and which aren't available in any commercial amplifier or kit, or you may simply have the urge to experiment with various circuits. A parts list generally accompanies such articles; if not, you can find the parts identified on the schematic diagram. If a parts layout diagram isn't supplied you can get a general idea of

the author's procedure from pictures that ordinarily accompany the articles, at least concerning the larger parts. But you must procure all the parts as well as scribe and cut the chassis yourself. This method is recommended only for those



Completed kit amplifier with metal cage.

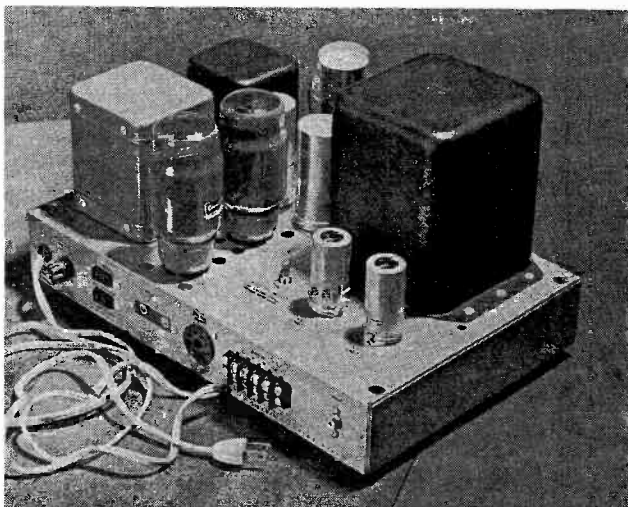
with a good deal of experience in construction.

Finally, you can design your own amplifier and then proceed as in the third method. Don't try to do this unless you have a thorough working knowledge of design theory as well as the practical experience to carry it through. Even then, your chance of winding up with a better amplifier than one of the standard designs or a commercial unit is mighty slim. All *well-known* circuits have been designed by competent engineers and subjected to long hours of de-bugging before release. If you do come up with something really good entirely on your own hook, of course, you'll have a valid reason to buy a larger hat.

Articles for the benefit of those who elect the third or fourth method of construction will be published in subsequent issues of *Audiocraft*. Most, however, will choose one of the first two alternatives, and it is primarily to them that the following remarks are addressed.

Basic Tools

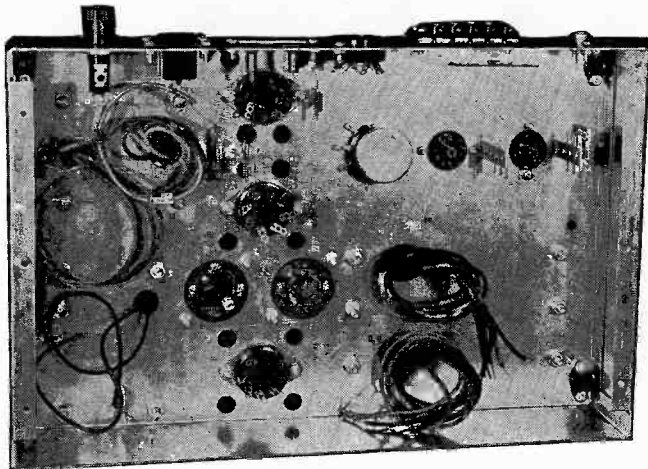
Good tools appropriate for the job can help you over the rough spots; inappropriate or inadequate ones only lead to frustration. One of the most inconspicuous but helpful items is a wire stripper adaptable to various sizes of wire. They are quite inexpensive, too; I paid 15 cents for one a few years ago that is still giving good service. Don't get one with a single V-slot that is supposed to be used for any wire diameter—you may



Heathkit W-5M amplifier that was assembled from kit parts. Appearance and performance can both be excellent, if due care is taken in construction.

score the wire itself badly enough that it will break off when it is bent a few times. If this happens after it is soldered to a tie lug, it's bad for the blood pressure. A pen-knife is often used also to remove insulation, and the same criticism can be made as for the V-slot strip-

Either plastic or push-back insulation is satisfactory; the former always looks neater and, though you don't have to use a stripper with the push-back type, you'll find that the insulation tends to push *itself* forward again—particularly on short pieces.



Amplifier chassis as it appears with all the major parts mounted. The power supply and output sections are wired first so as to anchor loose leads.

per: you're likely to cut the wire. The simplest satisfactory wire-stripper has three or more slots with sharp-edged circular ends of various diameters.

Another tool of major importance is the soldering tool. The older type of iron, although bulky and heavy, has much to be said in its favor. It is comparatively inexpensive and, if used with reasonable care, perfectly satisfactory. Pencil-tip, lightweight, straight irons are adequate for use in the smallest soldering operations, but it should be remembered that they can carry only a limited amount of heat and, consequently, are not suited to larger jobs. Gun-type irons with pistol grips and built-in spotlights are a little more expensive, but offer more convenience and versatility.

You'll need also one small and one medium-to-large screw driver, wire-cutting and needle-nose pliers, and a set of hex-nut drivers or a small adjustable wrench. If you're going to cut your own chassis you'll need a 1/4-inch hand or power drill with a set of drills for it; a reamer; a counterpunch; a brace and set of metal cutting bits including a fly-cutter, or a set of chassis punches; and usually a cold chisel.

Construction

Before beginning assembly of your kit, sit down for an hour and read the instructions carefully. Become thoroughly familiar with the procedure and plan of assembly at the start; examine the parts and get to know them. Then check them against the parts list. If any are missing, get them on hand before you start the assembly. If not supplied with your kit, be sure you have enough wire on hand. Generally, solid (not stranded) wire of about 20 gauge is easiest to work with.

When mounting transformers, sockets, controls, terminal strips and the like on the chassis, use lock-washers under nuts. Tighten firmly but not violently; you can strip or break off those little screws without half trying. If there are any controls or switches, slip on the knobs and rotate the body of the control so that the indicator marks on the knob are aligned with the proper panel marks, before you tighten the control nuts firmly.

If you've never done any soldering before, you would be well advised to practice a bit before proceeding with the wiring. Cut off and strip several pieces of wire, then join them by forming

in gaps in the joint. Remove the iron immediately after the solder has flowed. Overheating is bad for components such as resistors and capacitors. Since heat is conducted to them when you solder their leads, apply the soldering iron only long enough to obtain a spreading-type solder flow. Don't move any leads making up the joint until the solder has hardened—you can tell when it gets hard because the solder turns from a shiny silver color to a slightly grainy aluminum hue.

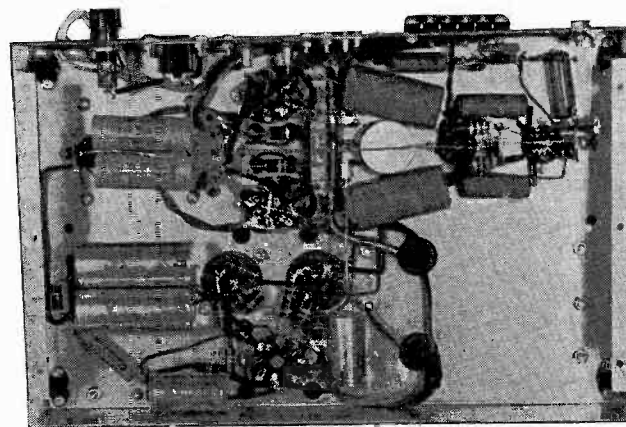
When you're satisfied that the soldering operation is simple enough after all, then you can go to work on the amplifier. If your kit is furnished with step-by-step instructions, follow them *exactly* and in order. One mistake is enough to prevent satisfactory performance of the finished unit, or any performance at all. So don't rush; make sure you understand clearly every step before proceeding with it, and check off each step as it is accomplished. Don't work too long at one time, either—fatigue greatly increases the chances of making an error.

If you don't have such instructions, and must work from a pictorial or schematic diagram, then your only guide is a few general rules. Here they are:

Wires carrying filament current, and those to the rectifier tube from the power transformer, should be twisted together and laid as close to the chassis as possible. For this reason (as well as to get them out of the way) they are ordinarily done first.

In order to avoid hum troubles, make all ground connection to a common wire or ground bus; then connect this to the chassis at one point only (usually near the input jack). The input jack shell can serve as a convenient connection point.

Use standoff terminal strip lugs liber-



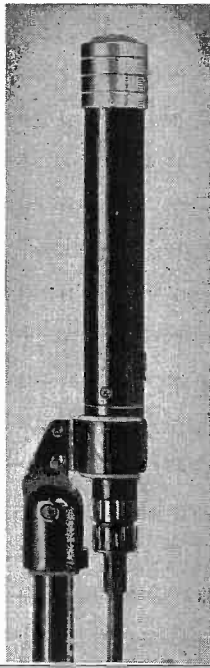
The amplifier as it appears completely wired. No special skill is required to build this except an ability to follow the directions.

reverse bends at the end of each wire, inserting one hook within another, and squeezing the hooks together with needle-nose pliers. Put just a little rosin-core solder (never use any other kind) on the tip of the hot iron to moisten it; place the tip on the joint to be soldered, and touch the solder to the joint (not the iron), letting it flow enough to fill

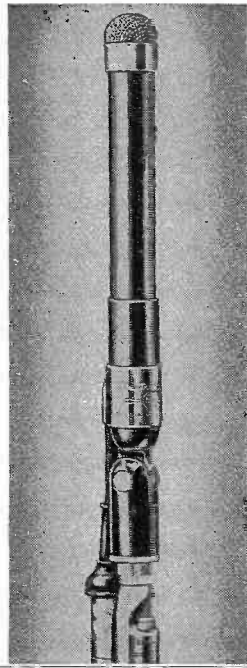
ally as tie points. They furnish mechanical stability for small components, and you'll find them convenient later for service work.

Make point-to-point wiring connections, generally, just after wiring the filaments and power supply and before installing components such as resistors

Continued on page 39



*Shure 530
Dynamic*



*Electro-Voice
655 Dynamic*



*Electro-Voice
636 Dynamic*



*Astatic "Dynabar"
DR-11 Dynamic*

Microphone Roundup *compiled by J. Gordon Holt*

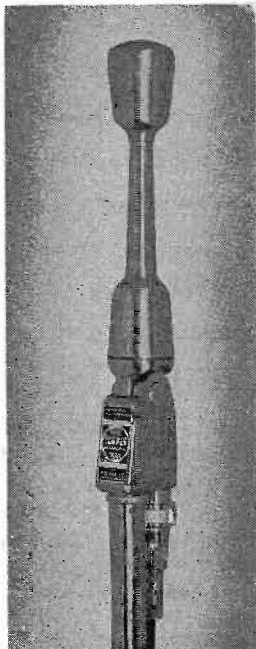
A SELECTION of some of the better microphones listed in current catalogues from 10 manufacturers. This is not a complete listing of all the available types, but is a sampling of those models that seem best suited for music recording, on the basis of all published quality ratings. All specifications were supplied by the manufacturers. Prices shown are catalogue prices, and may be subject to additional discounts.

GROUP I For use with recorders costing \$500 and up.

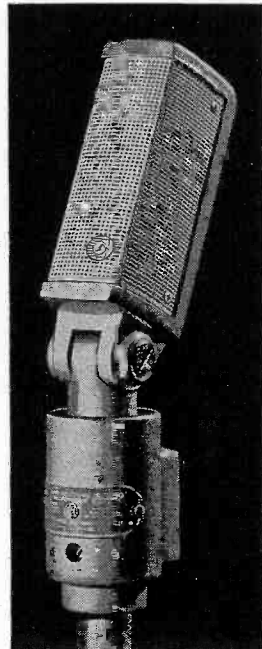
ALTEC M-11: Condenser microphone and power supply; omnidirectional; 20 to 15,000 cycles; GM -142 db; strap for 30/50, 150/250, or 500/600 ohms; \$230.00.

ALTEC M-20: Miniaturized condenser microphone and power supply; omnidirectional; 20 to 15,000 cycles; GM -142 db; strap for 30/50, 150/250, 500/600,

*Turner
ADA-95-D Dynamic*



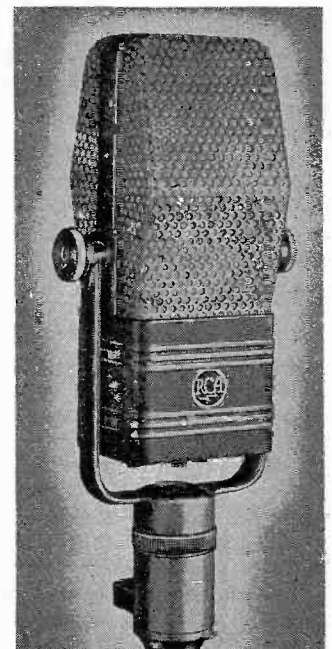
Shure 333 Ribbon

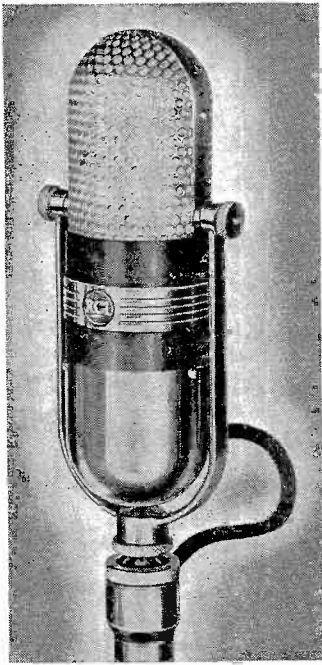


*Telefunken U-47-M
Condenser*



RCA 44-BX Ribbon

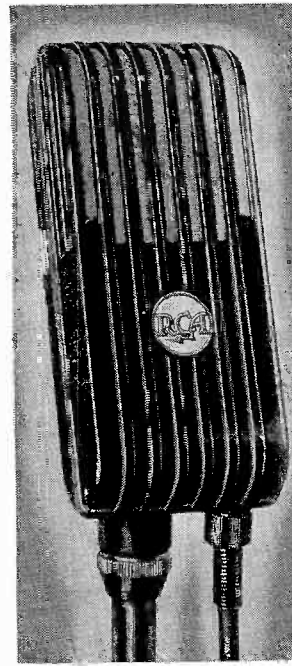




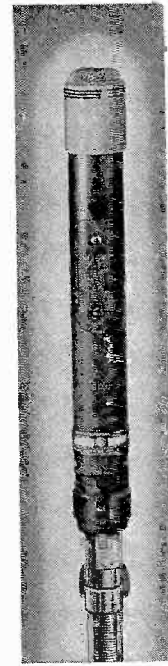
RCA 77-D Ribbon



Shure 55-S Dynamic



RCA SK-50 Ribbon



Shure 525 Dynamic

or 10,000 ohms; \$198.00.

ALTEC 670-A: Ribbon; polydirectional; switch selects unidirectional, bidirectional, or omnidirectional; 35 to 15,000 cycles; GM —152 db; switch selects 30/50 or 150/250 ohms; \$135.00.

ALTEC 639-B: Ribbon-dynamic; polydirectional; switch selects unidirectional, bidirectional, omnidirectional, and three intermediate patterns; 40 to 10,000 cycles; GM —150 db; 30/50 ohms; \$234.60.

CAPPS DM-2050: Dynamic; omnidirectional; 50 to 15,000 cycles; GM —146 db; 50 ohms; \$88.00.

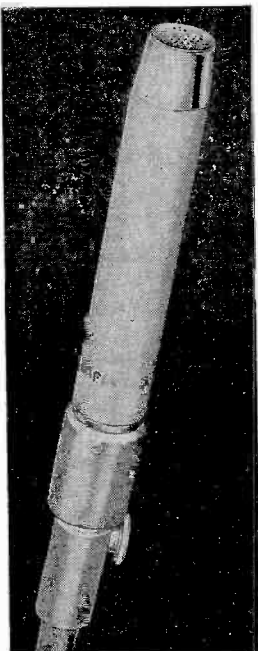
CAPPS CM-2011A, CM-2030A, CM-2250A: Condenser microphones with power supply; omnidirectional; 20 to 20,000 cycles; GM —158 db; CM-2011A Hi-Z, CM-2030A 30/50 ohms, CM-2250A 250 ohms; \$225.00.

CAPPS CM-2001: Condenser microphone with power supply; omnidirectional; 30 to 18,000 cycles; GM —158 db; Hi-Z; \$125.00.

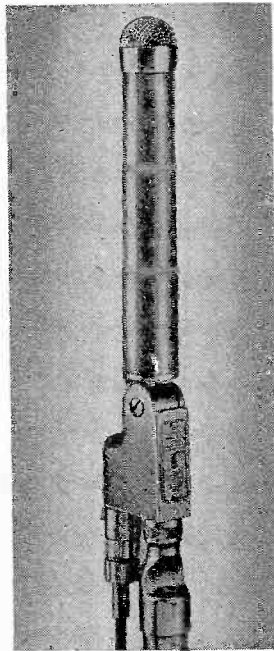
ELECTRO-VOICE 655C: Dynamic; omnidirectional; 40 to 20,000 cycles; GM —148 db; strap for 50, 150, or 250 ohms; \$200.00.

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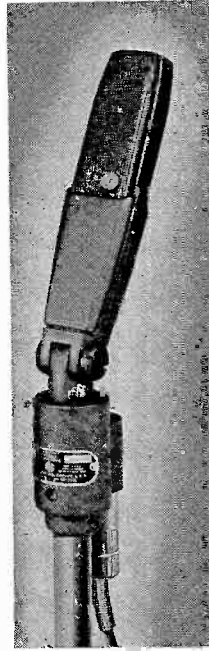
Capps "Studio" CM-2030 Condenser



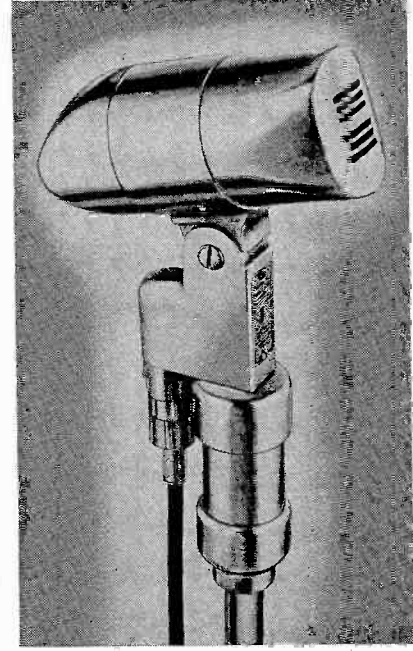
Electro-Voice 654 Dynamic



Shure 300 Ribbon



Electro-Voice 650 Dynamic



ELECTRO-VOICE 650: Dynamic; omnidirectional; 40 to 15,000 cycles; GM —142 db; switch selects 50 or 250 ohms; \$150.00.

ELECTRO-VOICE 665: Dynamic; unidirectional; 50 to 14,000 cycles; GM —148 db; switch selects 50 or 250 ohms; \$130.00.

ELECTRO-VOICE 654: Dynamic; omnidirectional; 50 to 16,000 cycles; GM —151 db; switch selects 50 or 250 ohms; \$95.00.

RCA 44-BX: Ribbon; bidirectional; 50 to 15,000 cycles; GM —149 db; strap for 30, 150 or 250 ohms; \$241.88.

RCA 77-D: Ribbon; polydirectional; switch selects unidirectional, bidirectional, or omnidirectional; 50 to 15,000 cycles; GM —151 db; strap for 30, 150 or 250 ohms; \$337.50.

SHURE 333: Ribbon; unidirectional; 30 to 15,000 cycles; GM —152 db; switch selects 50, 250 ohms or Hi-Z; \$250.00.

SHURE 300: Ribbon; bidirectional; 40 to 15,000 cycles; GM —152 db; switch selects 50, 250 ohms or Hi-Z; \$135.00.

SHURE 525: Dynamic; omnidirectional; 40 to 15,000 cycles; GM —155 db; switch selects 50/250 ohms or Hi-Z; \$200.00.

STEPHENS C-1 SYSTEM: Condenser microphone and power supply; omnidirectional; 20 to 20,000 cycles; nominal GM —109 db (lower outputs as desired); strap for 50, 250, or 600 ohms; \$298.00.

STEPHENS C-2 SYSTEM: Condenser microphone and power supply; omnidirectional; 20 to 15,000 cycles; nominal GM —129 db (lower outputs as desired); strap for 50, 250, or 600 ohms; \$182.00.

TELEFUNKEN U-47-M: Condenser microphone and power supply; polydirectional; switch selects unidirectional or omnidirectional; 30 to 17,000 cycles; GM —123 db; strap for 50 or 200 ohms; \$390.00.

TURNER 50-D: Dynamic; omnidirectional; 50 to 15,000 cycles; GM —151 db; strap for 50 or 200 ohms, or 150 ohms or Hi-Z; \$117.50.

GROUP II For use with recorders costing from \$250 to \$500.

ALTEC 633C: Dynamic; essentially omnidirectional; 35 to 15,000 cycles; GM —153 db; strap for 30/50 or 150/250 ohms; \$66.00.

AMPERITE R80H, R80L: Ribbon; bidirectional; 40 to 14,000 cycles; GM —146 db; R80H Hi-Z, R80L 200 ohms; \$80.00.

CAPPS DM-1060: Dynamic; omnidirectional; 50 to 12,000 cycles; GM —146 db; 50 ohms; \$57.00.

ELECTRO-VOICE 635: Dynamic; omnidirectional; 60 to 13,000 cycles; GM —151 db; switch selects 50 or 250 ohms; \$75.00.

ELECTRO-VOICE 636: Dynamic; omnidirectional; 60 to 13,000 cycles; GM —151 db; strap for 150 ohms or Hi-Z; \$70.00.

ELECTRO-VOICE 664: Dynamic; unidirectional; 60 to 13,000 cycles; GM —149 db; strap for 150 ohms or Hi-Z; \$79.50.

RCA SK-50: Ribbon; polydirectional; switch selects unidirectional, bidirectional, omnidirectional, and one intermediate pattern; 50 to 15,000 cycles; GM —150 db; strap for 30, 150, or 250 ohms; \$175.00.

SHURE 315: Ribbon; bidirectional; 50 to 12,000 cycles; GM —153 db; switch selects 50, 250 ohms or Hi-Z; \$79.50.

TURNER 51-D: Dynamic, essentially omnidirectional; 60 to 13,000 cycles; GM —153 db; strap for 50 or 200 ohms, or 150 ohms or Hi-Z; \$85.00.

GROUP III For use with recorders costing up to \$250.00.

ALTEC 660A, 660B: Dynamic; essentially omnidirectional; 40 to 10,000 cycles; GM —151 db; 660A 30/50 ohms; 660B strap for 30/50, 150/250 ohms or Hi-Z; 660A \$45.00. 660B \$50.00.

AMPERITE RBHG, RBLG: Ribbon; bidirectional; 50 to 11,000 cycles; GM —152 db; RBHG Hi-Z; RBLG 200 ohms; \$42.00.

ASTATIC DR-10: Crystal; unidirectional; 50 to 10,000 cycles; GM —154 db; Hi-Z; \$37.25.

ASTATIC DR-11: Dynamic; unidirectional; 40 to 10,000 cycles; GM —152 db; switch selects 50, 250, 500 ohms or Hi-Z; \$68.00.

ELECTRO-VOICE 630: Dynamic; omnidirectional; 60 to 11,000 cycles; GM —149 db; supplied in 50, 250 ohms or Hi-Z; \$47.00.

SHURE 55-S: Dynamic; unidirectional; 50 to 15,000 cycles; GM —156 db; switch selects 50-250 ohms or Hi-Z; \$76.50.

TURNER ADA-95D: Dynamic; omnidirectional; 70 to 10,000 cycles; GM —154 db; supplied in 50, 200, 500 ohms or Hi-Z; \$35.00.

TURNER 57, 57-A: Dynamic; omnidirectional; 50 to 13,000 cycles; GM —151 db; strap 57 for 150 ohms or Hi-Z, 57-A for 50 or 250 ohms; \$57.00.

Turner 57 Dynamic



Turner 50-D-TV Dynamic



FM in your Car

by John E. Lauer

WITH only a few modifications, a standard FM tuner can be adapted for mobile use and will give high fidelity performance. In a city having an FM station reception can be nearly perfect. Fringe area reception, say 20 to 30 miles from a weak station or 50 miles from a strong station in flat country, is possible also but presents a more involved problem — mainly with regard to an antenna. Commercial mobile FM tuners and converters are now available too, but some may not have the sensitivity that is necessary for good results in fringe areas.

The mobile receiver I have had in operation for the past three years has given satisfactory reception on Detroit stations in Ann Arbor, 40 miles away, and excellent reception from WUOM (44,000 watts at that time) up to 50 miles away, with still satisfactory reception at 80 or 90 miles. In my present location at Boulder, the terrain presents difficulties: the Denver transmitters are at Golden, only 25 miles away, but with a low range of mountains in between. KFML, the low power good-music station, can be adequately received over only half of Boulder. The inadequacy of the signal causes fading with changes in antenna position, the result of reflections from ground objects. Since the wave length is 10 ft., this appears as a 2 to 5-

cycle wobble in amplitude; if the signal is weak enough it disappears in the nulls, which causes the tuner to give its off-station hiss. One gets accustomed to stopping at lights and parking at points of maximum signal rather than nulls, when listening in a fringe area.

The installation described is constructed from Collins Audio Products equipment: an FMF-3 RF tuning unit and an IF-6 IF strip. Since the tuner was composed of subassemblies, the case could be made of "dairy tin" to match the Ford dash; this is shown in Fig. 1. Ford hardware was used also. Filtered power is supplied by a dynamotor under the hood. The antenna is an Alford loop, but a standard broadcast whip antenna is entirely adequate for strong-signal areas. The tuner feeds the regular car radio audio stage, which has been modified to extend the high frequency response to 12,000 cycles. A rear speaker, with the trunk as a bass-reflex enclosure, extends the low end to well below 100 cycles.

Tuner Requirements

The proper selection of a tuner will do much to eliminate any difficulties in the assembly and operation of a mobile FM installation. Any tuner that meets these requirements will serve: tubes should have 6-volt filaments, so that they may

be run off the battery directly (except for a noise filter). For a car with a 12-volt system, it may be simplest to use dropping resistors to obtain a 6-volt supply, since the filaments are carefully decoupled and changing them to series-parallel operation would be quite awk-

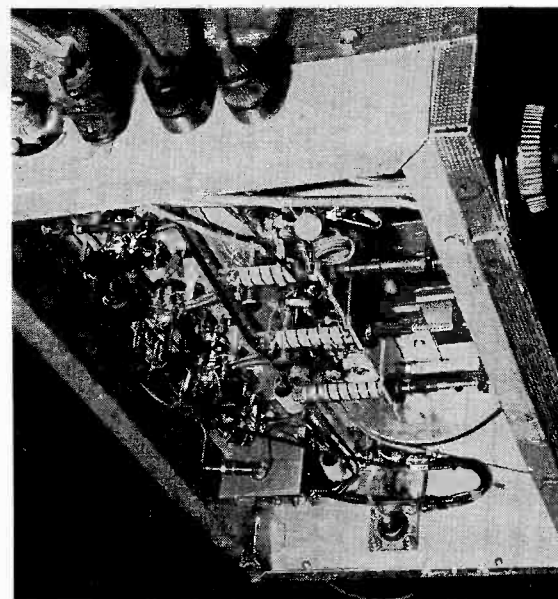
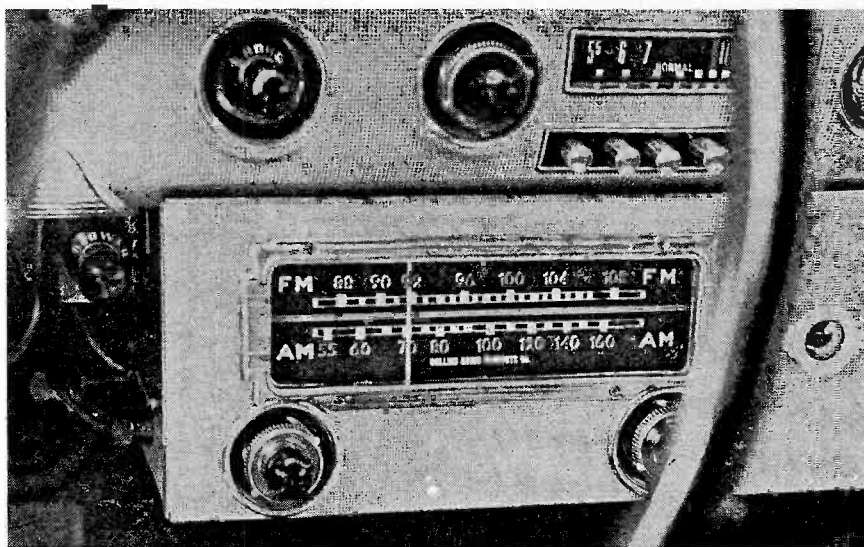


Fig. 2. View with bottom cover removed.

Fig. 1. Tuner enclosed in perforated-metal case matching Ford dash. Note tuning eye.



ward. A tuner with shock mounts is convenient and more likely to be trouble-free. Sensitivity should be high, particularly if fringe area reception is desired. This is especially true since fine-music FM stations tend to use low modulation, which makes any noise more troublesome. It is quite pointless to give a microvolt sensitivity figure for this requirement; sensitivity figures from various manufacturers are seldom comparable. The tuner should have automatic frequency control (AFC), since only when critically tuned will interference and static be eliminated. Ignition noise from other cars can often be heard when listening to a weak signal.

Since the supply voltages change with motor speed, the tuner may tend to drift unless it has AFC. The early Collins FMF-3 (which I use) does not have AFC, although later ones do, I believe. After experiencing some drift, associated with low motor speed, I added voltage

regulator tubes (an OA2 and OB2 to give 265 volts) to hold the B+ voltage constant. Any tube manual gives design specifications for such regulators. This eliminates most all the drift from that cause, and it seemed easier than trying to add AFC. A tuning eye is unnecessary, in general, since tuning to eliminate ignition noise or static can be accomplished by ear.

Again for fringe area reception, a squelch circuit might be useful in eliminating the intermittent hiss associated

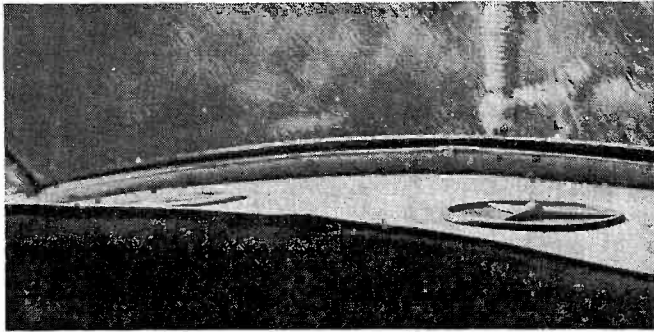


Fig. 3. A rear-deck bass-reflex mobile speaker installation.

with a fading signal, but the squelch would have to be fast-acting. Several commercial tuners have slow-acting squelch circuits, so designed since their only function is to eliminate noise while changing stations.

Modification of Audio System

It will usually be convenient to mount the tuner under the center of the dash somewhere (one might also consider putting it in the glove compartment); then cables can be run conveniently to the 6-volt power (through the ignition switch), to the B+ supply, and to the antenna. See Fig. 2. A phono socket to the audio stage, and a shielded cable with a phono plug from the volume control, can be installed in the AM car radio, coming out any of the numerous vent holes. Then, if the FM tuner is removed, the cable can be jumped to the socket, allowing the AM radio to operate in the normal manner. This is convenient for trouble shooting each radio. A similar socket, and cord and plug, are mounted on the FM tuner so that when installed, the AM audio feeds through the two cables to the FM tuner for switching.

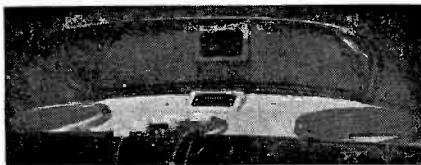


Fig. 4. Trunk-reflex speaker with tweeter.

In my installation, a 4-pole double throw rotary switch is used. This switches the audio, the 6-volt panel light supply from the dash dimmer, and the 6-volt supply to the filaments and dynamotor. A somewhat better arrangement

would use another switch section to ground out the AM audio, since it will be picked up slightly if it is left floating. Another solution is to remove the B+ from the RF and IF sections of the AM radio, and to use this to power the FM tuner if its requirements are small enough. This would eliminate the need for a dynamotor or separate vibrator supply.

In the audio output of the car radio, usually just before the output transformer, will be found an RC filter to

attenuate the high frequencies. The capacitor should be reduced to about one-half its present value, to extend the response. It probably should not be decreased to the point where the full audible range is reproduced, because distortion and static present in the AM would then be objectionable when that part is used. If the car radio has a tone

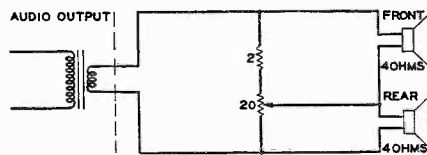


Fig. 5. Fader for front and rear speakers.

control with several positions, this may be used to change the response for AM and FM. The so-called "high-fidelity" or "music" position of such a control usually furnishes bass boost, causing booming lows at the resonance of the dash speaker, around 100 cycles. It should not be used.

The bass should be increased, however, by the addition of a rear speaker. This also greatly improves distribution of the sound, and results in improved comprehensibility of speech. The trunk can be used as a bass-reflex enclosure for the added speaker. Fig. 3 shows rear speaker and reflex port cutouts, covered by identical grilles. Another rear-deck bass-reflex installation is shown in Fig. 4; here a separate tweeter is used with its sound splashed against the rear window. Proper phasing of the front and rear speakers is determined when connecting them by reversing the connections to one and listening for the best low-frequency reproduction. If convenient, the two speakers should be balanced with a potentiometer, rather than

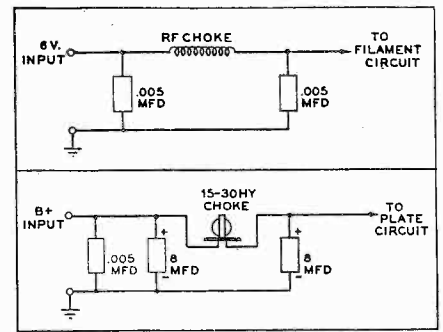


Fig. 6. Filament and plate supply filters.

just a switch. The usual circuit is given in Fig. 5.

Power Supply

The 6-volt filament and B+ supplies must be well filtered to keep all noise out of the tuner chassis. The 6-volt filtering can be done with bypass capacitors made for automotive use. If a choke is found necessary also it may be wound from wire heavy enough to carry the current, and need only consist of a dozen turns taken around a pencil, since it must filter only RF noise. This is then used in a π -section filter with two capacitors, as in Fig. 6. The B+ filter after a dynamotor is standard, consisting of two 8-mfd electrolytics and a filter choke. The circuit shown in the lower part of Fig. 6 should have a small bypass capacitor, .005 mfd, across the input to take care of RF noise.

The B+ supply could alternately be of the vibrator type, but this presents more stringent filtering problems and is usually more expensive. Or the AM power supply, if husky enough, could be removed from the RF, IF, and detector stages and used for the FM tuner. As long as suitable dynamotors, Fig. 7, are available on the surplus market they solve the problem easily. The dynamotor (or other supply) must be switched at the tuner, as already mentioned.

Noise problems will arise also from

Continued on page 42

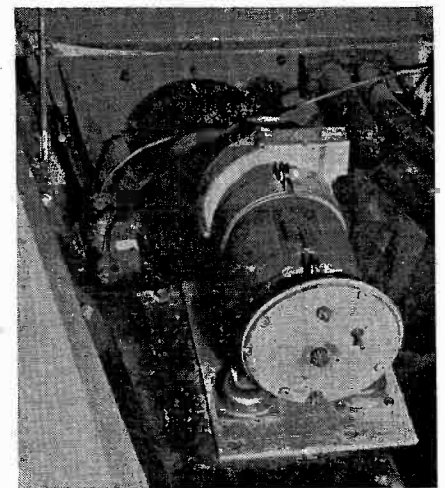


Fig. 7. Dynamotor for B-voltage supply.

Lebensraum for the craftsman

by R. D. Darrell

Nothing is more annoying, probably, than having to clear off your working-space several times during the course of a construction job. What can you do about it? Follow the advice given below!

NO amateur audio-craftsman ever takes to heart the axiom that "the laborer is worthy of his hire". For the quintessence of doing-it-yourself, in this or any other field, is that what may seem like work to others really is play — and its best reward is enjoyment of the activity itself.

Unfortunately, however, the hobbyist's fully justified relaxation of common sense in this respect too often is unwarrantably extended to cover the locale and conditions — as well as the incentive — of his work/play. And while it may be typical of the amateur in general that he tends to do things the hard way, there never is any real need for him to handicap himself hopelessly right at the start by failing to give proper thought to the setting and fittings of his combination workshop-playground.

Now, of course, few of us ever are gifted with space and equipment to match our ambitions: generally we're lucky if we can discover a clear corner in an attic, cellar, or garage; more often we have to depend on a grudgingly spared top shelf or bottom drawer for materials storage, and on the even more reluctant, temporary release of a bit of floor or table-top space for actual working area. Yet, while some home repair or construction miracles occasionally have been achieved under just these cramping limitations, such triumphs over environmental inconvenience and household tolerance are both too rare and too dearly bought. Against them must be balanced the heavy weight of defeat and discouragement in the innumerable instances of other potential craftsmen who found one such experience all they (or their families) could take, or who have been thwarted from completing (or perhaps even beginning) their first serious project.

The vital obstacle to genuine accomplishment under such unfavorable conditions is the disheartening waste of time and energy — since for every hour of purposeful activity, another must be expended simply in getting ready to work, and still another in packing and cleaning up afterwards. Nor is this handicap merely a physical one: the severest barrier is psychological. No matter what the external demands may be, we always can spare a half-hour or an

hour or two from most evenings or week-ends — if we know in advance that it can be wholly devoted to a specific project dear to our heart. But when we realize with dismay that the bulk of this "recreational" time must be wasted on unproductive labors, it takes unlimited enthusiasm to carry us through.

Make It Easy for Yourself!

The first rule, then, in undertaking any kind of home-craft activity is: *Make everything as simple, accessible, and comfortable as possible.* And its obvious corollary must be: *Reserve some reasonably permanent working-space,* where any specific project can be left without packing or cleaning up, at least as long as it's in the course of completion.

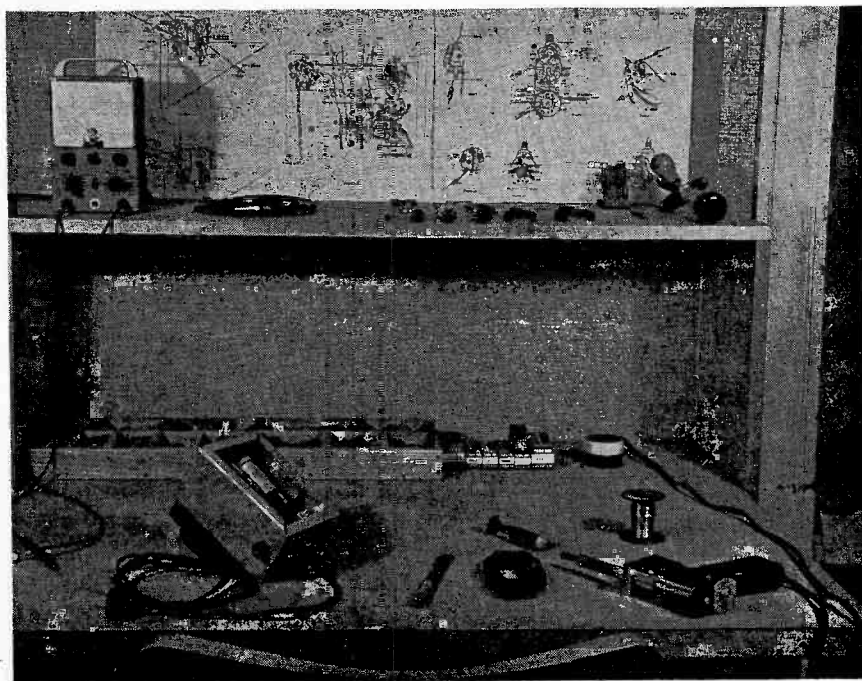
This doesn't mean that you *have to* have a special audio workbench, although of course that's the ideal. But if you have to make do with, say, a wood-working bench or even a utility table-top, it does mean that you should firmly stake out and protect your claim to that space for as long as your particular test, repair, or assembly job is "in process". Thus, all equipment and tools can be left

undisturbed overnight or through the week (if necessary, discreetly concealed by a drop-cloth), so that whenever you have time free — no matter how short — to work on it, every minute can be spent directly and unhurriedly on the job itself — and the nuisances of setting-up and cleaning-up have to be faced only once at the very beginning and end.

The first rule also implies that you make careful preparations before you undertake any project to ensure that you can work later with maximum ease. You make sure, for example, that your bench or table is illuminated by a good, strong, shaded light (*not* of the electronic-noise-producing fluorescent type) . . . that you have a comfortable, sufficiently high chair or stool to sit on . . . and that there is space available not only for the chassis on which you're working, but also — within easy reach or eye-shot — for whatever tools, test gear, schematics, tube handbooks, etc., are likely to be constantly used.

Until you have progressed from simple home-system checks and repairs, or assembling and testing "kits," to

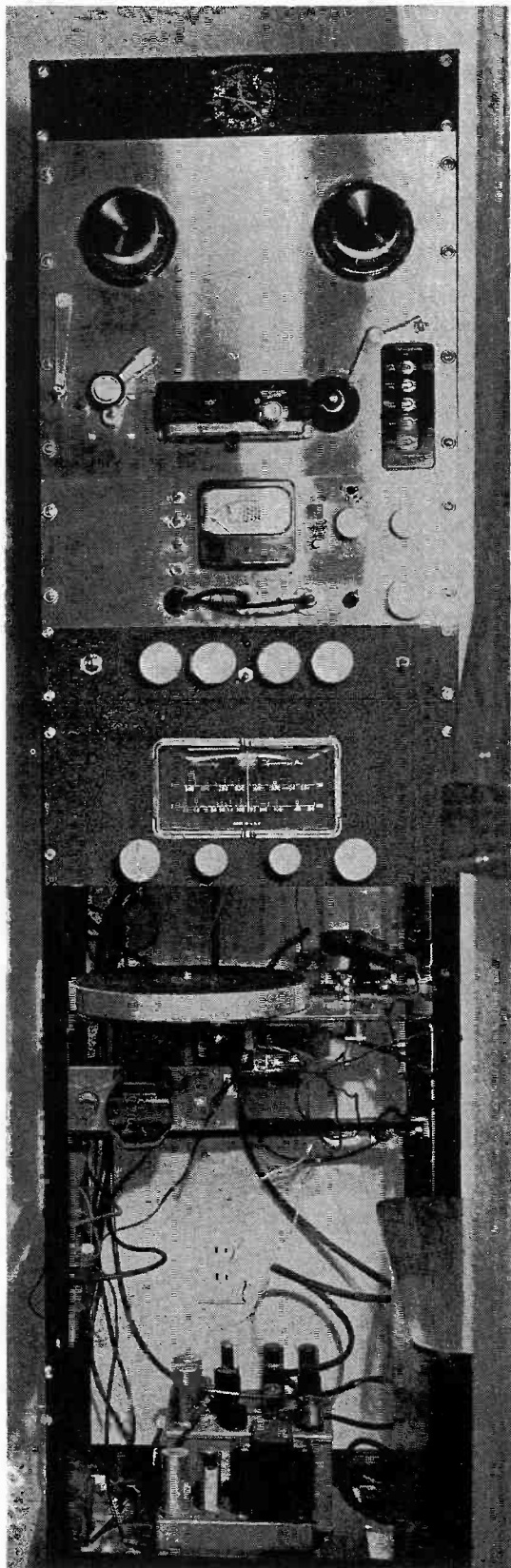
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This workbench arrangement is convenient and takes little space — and it's all yours.

HOW THEY DID IT

Details of unusually interesting audio systems.



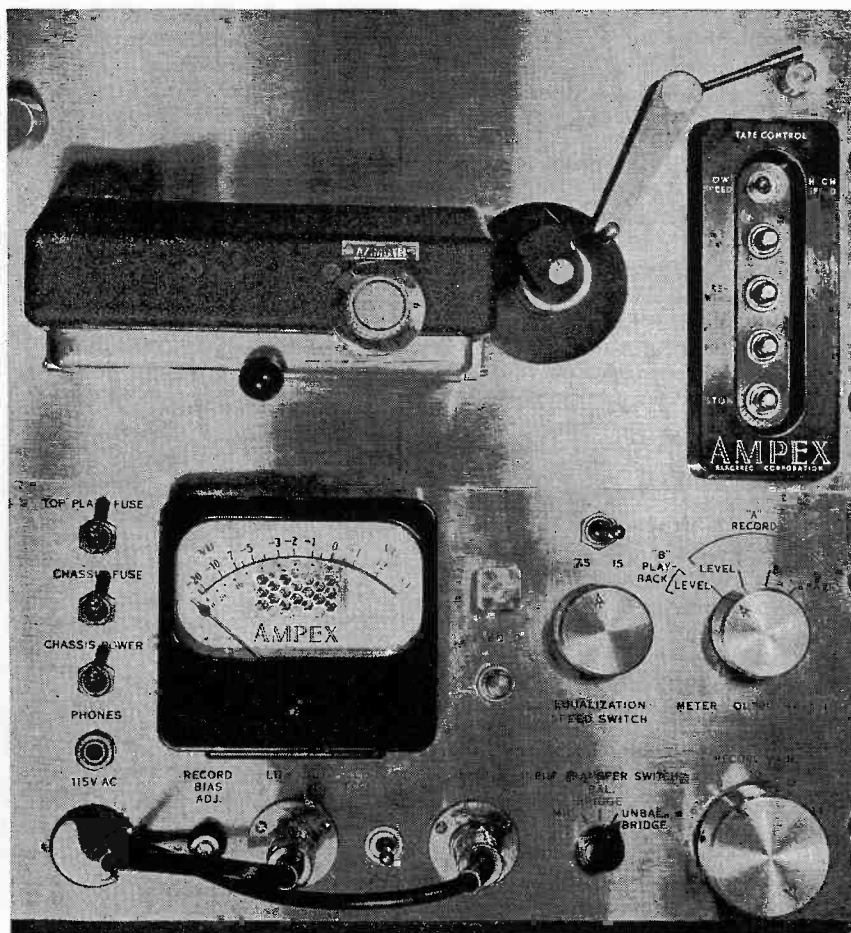
A LONG-TIME record collector, Richard H. Cobb, Jr. turned to tape immediately when it became available and now has what is probably the world's largest private collection of tape recordings. Some of the approximately 1,700 reels, neatly boxed and catalogued, that make up this treasure are shown in the picture at the top of the opposite page. This is part of one listening-room wall in Mr. Cobb's Sarasota, Florida, home.

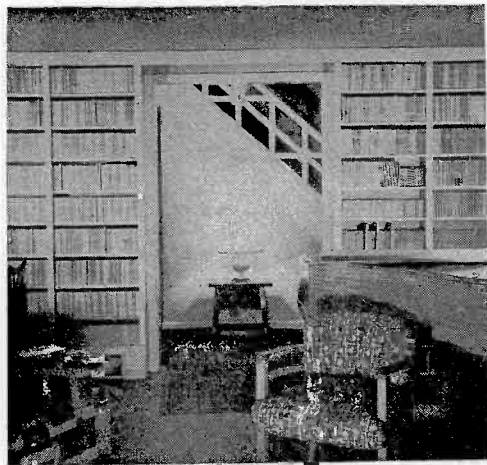
Since he began his tape library nine years ago there have been many changes in the equipment setup; for instance, he has had at various times nearly a dozen tape recorders. He records primarily from disc records and radio, and has had manufactured to his specifications a rack to hold the current recording and playback equipment. This (shown at the left) is installed in a closet off the main listening room. For operating ease and maintenance availability the rack mount-

ing system is unsurpassed. Then, too, it is readily adaptable to new equipment; there isn't any problem of recutting panels when old built-in units are replaced. Finally, the rack system is far less expensive than custom-built cabinets. Though some may object to its appearance, this is hardly pertinent when the rack is in a closet. The only thing visible—and audible—in the listening room is the Altec 820-A speaker system, shown on the opposite page.

Components on the rack, from top to bottom, are as follows:

- 1) 24-hour clock with sweep-second hand and date indicator.
- 2) Ampex 400-A tape transport assembly, with modifications that will be described subsequently.
- 3) Ampex 400-A amplifier assembly, modified. The switch at the upper right on this panel, over the tape speed bias equalizer, controls an automatic tape





tension relief mechanism that prevents overtight rewinding, so as to minimize print-through and tape stretch, and permit storage of tape, rewound and ready for playing. Switches in the center of this panel provide for independent operation of the tape transport and amplifier sections.

4) McIntosh AE-2A preamplifier-control unit. The switch at the left controls AC power for all the components through a multiple-outlet board on the lower left side of the rack. The turntable motor is controlled by the switch on the right.

5) Browning RJ-12C FM-AM tuner.

6) Rek-O-Kut CVS-12 variable-speed turntable and Gray 108-B viscous-damped arm. Cartridges are GE, and a GE phono preamplifier is used.

7) Ampex 400-A power supply.

8) McIntosh 20W-2 amplifier, at the rear: Browning tuner power supply at the front.

Not on the rack, but in the closet, is a dehumidifier which Mr. Cobb says is essential in Sarasota.

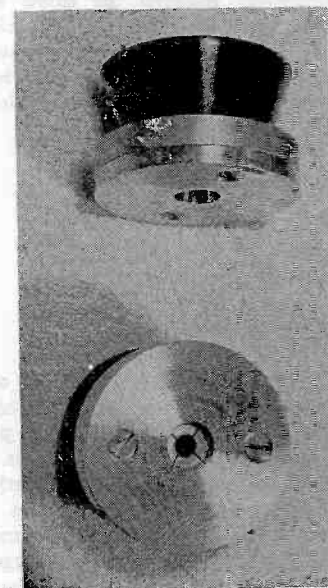
The photo at the lower right is of reel adaptors for the Ampex that were designed by Mr. Cobb. To the standard reel holders are attached aluminum discs $17/64$ in. thick and of $2\ 61/64$ in. diameter, with an $11/16$ -inch center hole each. Their function is to facilitate interchanging small reels with NARTB reels. When a large reel is to be used, after removing a small one, the reel holder is tightened against the base of the reel spindle. The NARTB reel can then be snapped in place without further adjustment. When using a small reel the holder is tightened flat against the outside of the reel just as though the added disc were not there.

There are some important modifications to the recorder transport also; see the photograph at the lower left. The arm-and-plunger arrangement is for rewind tension control, as described previously. On the VU meter is a honey-comb plastic contrivance that will be an indicator for an automatic volume limiting circuit, now under development. The dial knob on the head cover is attached to a shaft that adjusts the playback head azimuth angle—since Mr. Cobb has tapes recorded on several different machines, each of which had a

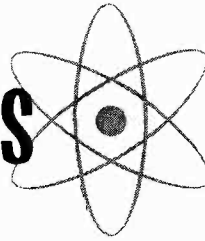


record head situated at an angle probably close to but not exactly 90° to the tape, it is essential to have some simple means for adjustment of the playback head to correspondence with the original. Once he makes the first adjustment for maximum high-frequency response by ear, he notes the dial marking on an index card and can use this to return to the proper setting for that tape on subsequent plays.

Index cards are used, of course, to keep the extensive tape library in order. In addition to the azimuth note, the cards carry information on the composer and work, location of the tape in the library, performer, date of performance and date of recording, duration of the work, recorder used, tape speed and tape manufacturer, and notes on the performers' ability and interpretation as well as technical quality of the recording.



BASIC ELECTRONICS



The Nature of Electricity

by Roy F. Allison

THOUGH a working knowledge of circuits and circuit elements can be gained without knowing why they behave as they do, and this sort of acquaintance with electronics is relatively common, it is always more satisfying to know "the reason why". Anyone familiar with effects only is less equipped to handle unusual situations, and is able to do less original thinking, than he would be with a knowledge of what causes those effects. Fortunately, these basic matters can be presented and absorbed in a relatively painless way by making use of physical interpretations, as opposed to the usual textbook emphasis on mathematical treatment.

In this series we shall, accordingly, use the physical-concept approach and avoid rigorous mathematics wherever possible. This is not to say that no math will be used; a few simple formulas are basic to electrical computations and must be included. In no case, either, will we knowingly commit the cardinal sin of most "simplified" treatments of technical subjects—that of compromising accuracy for the sake of clarity.

Atomic Structure

All substances can be resolved into one or more of the 92 natural elements, the basic constituents of matter. An element (a substance such as copper, silver, oxygen) is composed of incredibly small bits of matter called atoms: in a pure elementary material the atoms are all alike, but they differ for each element. The differences in atomic structure are responsible for the differing chemical and physical properties of the elements.

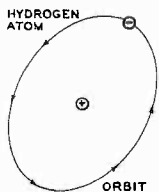


Fig. 1

Still, atoms themselves differ only in structure. They are composed of common building blocks: electrons, protons, neutrons, positrons, and mesons. Electrons are extremely minute particles—it would take 31 billion billion billion of them to weigh an ounce—and each has a tiny discrete electrical charge. This charge is arbitrarily labeled negative.

The electron is the fundamental electrical particle.

Protons are some 1,800 times heavier than electrons (still not very weighty!) and each has a charge equal in amplitude to an electron. However, the proton's charge is of opposite polarity; it is a positive charge. A neutron has very nearly the same weight as a proton but is neutral, having no charge. Positrons are similar in weight to electrons but have opposite charges: mesons are charged particles several hundred times as heavy as electrons. Neither of the last two particles is of concern in this discussion.

All atoms can be visualized as having a central core, or nucleus, around which electrons revolve like planets around a sun. The nucleus contains protons in number equal to the normal amount of circumnavigating electrons, and neutrons varying in quantity according to the element. Hydrogen is the simplest atom, with a single proton as the nucleus and one peripheral electron. This is shown in Fig. 1, although not to scale. Actually the relative separation is far greater; if the electron is assumed to be earth-size then it would be at least 100 million miles from the nucleus, which would be about the same size as the earth also. Yet this miniature solar system, with its relatively vast empty space, is only four one-billionths of an inch across!

As atoms increase in complexity (and weight—hydrogen is the lightest element) more and more protons and neutrons appear in the nucleus. There appears to be no fixed relation determining the proportion of protons to neutrons, although the neutrons are slightly more numerous in most cases. For each added proton, another electron appears to balance the electrical charge. The electrons build up in shells, so-called; a shell is a number of electrons having about the same orbital distance from the nucleus. The K shell, closest to the nucleus, never has more than two electrons. For example: we have seen that the simplest atom (hydrogen) has one proton and one electron. Fig. 2A shows this diagrammatically. Next in the atomic series is helium, with 2 protons, 2 neutrons, and 2 electrons. Both electrons fall into the K shell, Fig. 2B. Third in the series is lithium, Fig. 2C; this has 3 each of protons and electrons. For some reason the K shell refuses to accept the third

electron and it takes an orbit outside the other two, beginning the L shell. In the elements beryllium, boron, carbon, nitrogen, oxygen, fluorine, and neon, electrons are added successively to the L shell, to make a total of eight with neon. But in the sodium atom, Fig. 2D, the L shell will accept no more electrons; the eleventh electron takes an orbit still more distant from the nucleus—the M shell. The series builds up again through argon, which has eight electrons in the M shell, and potassium, which has one electron in the N shell; through krypton, with eight electrons in the outer shell, and rubidium, with one electron in the O shell; and so on through the entire series. In elements after potassium, the number

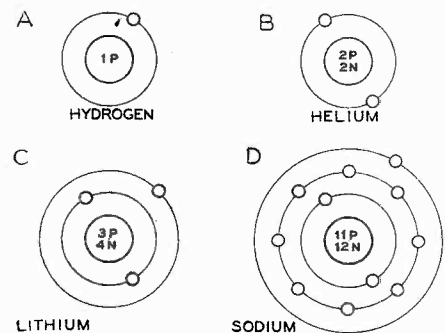


Fig. 2

of electrons in shells from M onward increases above eight, but in no case is there ever more than eight in the outermost shell.

Now, it is a characteristic of atoms that they are more stable with completely-filled outer shells than without. This results in the tendency of atoms with one to three electrons in an outer shell to lose them readily, and of those with five to seven electrons in an outer shell to pick up the amount required to complete the shell. Those with four outer electrons may tend toward losing or gaining; those with complete shells tend neither to lose nor gain electrons. This phenomenon is responsible for chemical reactions, or the formation of compounds. Sodium has one electron in its outer ring, and chlorine has seven—it lacks one to complete its outer shell. These elements will combine with facility to produce the ionic compound sodium chloride (table salt). There is an actual transfer of the sodium atom's "extra" electron to the chlorine atom's

outer ring; this charges the sodium atom positively and the chlorine atom negatively. The combination, of course, is neutral. The individual atoms are grouped regularly in crystalline form, as shown in Fig. 3, and it requires a great amount of effort to return them to their pure-element states.

In like manner the sodium might have combined with fluorine or any element having a normal inadequacy of one electron in its outer ring. Alternatively,

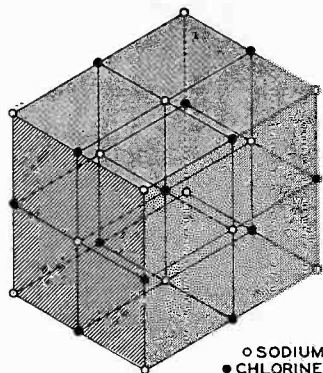


Fig. 3

two chlorine atoms may combine with one of calcium, which has two electrons in its outer ring and can, therefore, complete the rings of both chlorine atoms. The total number of possible chemical reactions, while not actually limitless, is certainly very large. The gases helium, neon, argon, krypton, xenon, and radon are inert; that is, they do not enter into chemical combinations because their outer rings are complete electron octets.

It may seem at this point that we have digressed into chemistry. The reason will be clear presently.

Electric Charge

Probably everyone is familiar with the classical story of the Greek philosopher Thales, who noted that when he rubbed a piece of amber with cloth the amber could attract nearby light objects. Glass rubbed with silk, and vulcanized rubber stroked by fur, behave in the same way, as do other common objects. If you wear rubber-soled shoes and walk across a rug in dry weather you may be dismayed to receive a slight electric shock when you touch a door handle; your hair may refuse to behave properly if you comb it dry with a hard-rubber comb.

The explanation for these effects is quite simple, and is identical to that for chemical combinations: atoms are more stable with completed outer shells. Glass has more atoms with "extra" electrons than silk, or silk has more atoms slightly deficient in outer-shell electrons than does glass, or both; the important matter is that there is an inequality of stable atoms between the two materials. When they are brought into intimate contact and energy is supplied by the rubbing action, electrons from the glass surface

atoms escape to the silk. When this happens the silk, which now has more electrons than protons, becomes charged negatively. The glass has more protons than electrons, so that its charge is positive. Fig. 4 shows this in a qualitative way only—the quantities are not supposed to be representative.

An important point to make here is that the tendency toward neutralization of charge is stronger than the tendency toward shell completion. If you touch the silk to the glass again, without rubbing, electrons will flow back to the glass rod so as to equalize the charges almost completely. If you had not rubbed the materials together in the first place, but had simply joined them, very little electron transfer would have occurred. And even after charging the two by rubbing, the charges will slowly leak away by contact with the atmosphere.

The same effect (except in reverse) is obtained when you stroke a hard rubber rod with fur. In this case, because of the different natures of the preponderant atoms in the materials, electrons go from the fur into the rubber; the fur assumes a positive charge and the rubber a negative one. Remember that a negative charge indicates an excess of electrons—a positive charge means a deficiency of electrons.

Now is the time to perform another classic experiment. Let's suspend a pair of pith balls from individual threads; the balls should be fairly close together

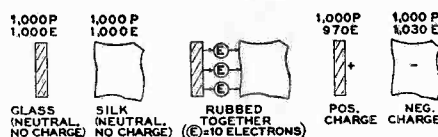


Fig. 4

but not touching, say an inch apart. See Fig. 5A. Charge the glass rod as before, and touch both balls with the rod. They will fly apart, as in Fig. 5B, and will stay apart for some time if the air is reasonably dry. Grasp both pith balls and hold them for a few seconds, so as to assist in their neutralization by leakage to the atmosphere or to ground. Now charge a rubber rod and touch it to both pieces of pith; again, they will fly apart. Neutralize the balls again, and after charging both the rubber and glass rods, touch one rod to one ball and the other rod simultaneously to the other ball. (Remember that one rod is positive, the other negative.) Immediately the pith balls will swing toward each other and will remain close until neutralized. If the charges are strong enough, and the balls were originally suspended closely enough to touch when they swing together, the opposing charges will be largely neutralized at the moment the balls touch one another; in that event they will return to the vertical positions they occupy when uncharged.

This is a simple but effective demon-

stration of an important pair of facts: unlike charges are mutually attractive; like charges are mutually repellant. The fundamental import of these phenomena cannot be overstated. They are effective throughout all physical relationships. For instance, protons are grouped closely together in atomic nuclei in spite of their mutual repulsion; the binding energy that keeps them together must be extremely high. That it is indeed great was proved at Hiroshima and Nagasaki. Electrons spin about the nucleus in energy shells, as we have seen, and are prevented from flying off willy-nilly only by their mutual attraction with the positive nucleus. They achieve an electrostatic balance against centrifugal force in much the same way that planets in their orbits achieve a gravitational balance with a sun.

The pith ball was charged by bringing the positive glass rod in physical contact with it, because the positive rod attracted electrons from the ball; a physical transfer of electrons occurred. When the rod was withdrawn the ball had a deficiency of electrons, making it positive. With the negative rubber rod a transfer took place in the other direction because the excess electrons on the rod were mutually repellant, and some were pushed off to the ball when contact occurred.

Conduction

Suppose we recharge both rods, glass and rubber, and assume that the charges are equal. Then we touch them to opposite ends of a thin glass rod. When the charged rods are withdrawn and tested on the pith balls, they are found to have lost very little of their charges. The same is true if they are touched to opposite ends of a sheet of paper, or a rubber mat, or any other common insulating material. But touch the charged rods to opposite ends of a length of copper wire, or to separate points on any common metal object, and then test them on the pith balls—it will be found that the

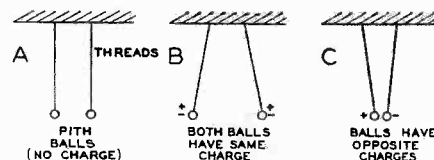


Fig. 5

charges have disappeared almost entirely.

Metals are generally good conductors of electricity, so the excess electrons in the charged rubber rod found, in the copper wire, an easy path to the glass rod, which was deficient in electrons and absorbed them quickly. By throwing off the excess and replenishing the deficit, the two rods neutralized themselves via the wire. The insulators, on the other hand, did not provide an easy path for

Continued on page 39

LEBENSRAUM

Continued from page 33

more ambitious chassis-building projects, the essential audio-tool requirements are surprisingly few. You can begin with only a soldering iron (preferably of the instant-heating "gun" type); liberal supplies of rosin-core "wire" solder, plastic insulating tape, No. 20 hook-up wire (preferably solid rather than stranded), and "spaghetti" (plastic sleeving for bare wires and joints); a pair each of long-nose pliers and diagonal wire-cutters; a knife or preferably a special wire-stripping tool; and a neon-lamp voltage-and-current checker—these augmented as needed by assorted screwdrivers, wrenches, etc., which usually may be borrowed from more generalized home-shop supplies.

The novice usually tends to accumulate (or at least want) more tools than he really needs. But on the other hand, he also tends to neglect certain other highly convenient accessories, such as a really plentiful supply of clip-leads in different lengths and colors, and an adequate batch of plastic boxes, trays, or cookie tins for holding easily lost small components.

Similarly, the inexperienced audio craftsman is likely both to over- and under-estimate his immediate test equipment needs. Eventually he can make good use of a vacuum-tube voltmeter (particularly a VTVM especially designed for low audio voltage measurements), an audio signal generator, and perhaps above all an oscilloscope. Tube and capacity checkers always are helpful, and, for advanced workers, so are impedance bridges and transmission measuring sets. But these are best accumulated gradually, with one's growing experience, and in any case require long-range budget stretching even when they are obtained most inexpensively in kit form. At the very beginning, the only absolute essential is a multitester (i. e., combination AC/DC voltmeter, ammeter, and



ohmmeter), but since this will remain an indispensable tool no matter how much fancier gear is added later, it should be a good one—even a duffer is wise to spend at least \$30 or \$40 for a really dependable, sturdy model.

There are other needs, however, which both experienced and novice audio

craftsmen almost invariably underestimate: in particular that for many easily accessible 60-cycle AC power outlets. The best way to meet this need is with a power receptacle *strip* permanently fastened to and preferably running the full length of the work bench or table. Next best is a set of sturdy multiple-receptacle blocks. But in either case these should be *permanently* connected (if at all possible) via BX cabling to a household power-line outlet box—preferably to a line separate from that used for the workroom lighting, but in any event embodying a separate, independent fuse or circuit breaker.

Safety Precautions

This naturally brings us to another literally vital audiocraft home set-up consideration: that of safety. Many novices are likely to exaggerate the possible dangers involved, but most slightly experienced hobbyists go to the other extreme of unduly minimizing them. The fact is that the most apparent danger—that of shock—commonly is less serious (although it never can be ignored or slighted) than that of damage or fire resulting from *shorts*.



Avoiding shocks demands only unremitting vigilance and such obvious precautions as making it an *invariable* rule never to work on energized equipment except when absolutely necessary, and then *only* with insulated-handled tools or probes, and with one hand held behind one's back.

But even the most careful worker runs the constant risk of accidentally shorting either internal DC or external AC circuits: hence the desirability of fusing all equipment power-transformer primaries (and sometimes the secondaries as well), and the absolute necessity of fusing the main powerline to the audio workbench. Moreover, when a permanent, fused power line is *not* provided and the "craftsman" recklessly relies on a haywire assemblage of tangled power cords, he risks not merely frequent main power line entry-box fuse blowing, but the disqualification of his household insurance in case an actual fire should develop.

Above all, take special care whenever you have to work on any AC/DC radio receiver, for unless its power plug is correctly polarized it can be an extremely dangerous shock-and-short menace. For

bench-testing or repairing such receivers, a small (150- or 200-watt) isolation transformer is an absolute necessity. It's a good investment in other ways, too, for its use in actual receiver operation also eliminates many of the hum troubles inevitable whenever such AC/DC tuners



are hooked into home amplifier-and-speaker systems.

But the main consideration in electronic safety is closely akin to those affecting efficiency and convenience in home-workshop practice: the simpler, more permanent, and more foolproof, the better! If you have a chance visit a professional electronic shop or laboratory and take dutiful note of how the pros go about their work. In any case, never forget that the thought and care you expend *in advance* of your actual test, repair, assembly, and construction activities can save you incalculable later waste of time and money—to say nothing of psychological headaches and physical hazards! It's a cheap investment, but the rewards are great.

JENSEN IMPERIAL

Continued from page 20

Now stand the cabinet upright and install the M-F/H-F assembly, situating the front of the array approximately $1\frac{1}{4}$ in. behind the front face of the cabinet. Use No. 8 by $\frac{1}{2}$ -inch R. H. wood screws to hold the front brackets to the top shelf. Remove the center bolt holding the back cover of the larger unit of this assembly, and replace through the long leg of the L bracket. Fasten the foot of this L bracket to the cabinet top with No. 8 by $\frac{1}{2}$ -inch R.H. wood screws. Adjust the horn array for level position and tighten the cover bolt. Drill a small hole through the top shelf and pass both cables of this assembly through into the network compartment.

Next install the balance control escutcheon cups from the balance control accessory kit, using the 6 wood screws provided. Place the M-F balance control cup in the opening nearest the front. Now attach both balance controls to the cups, using the lock nuts provided; lugs on the controls fit into holes in the cups for positive location.

Drill a second hole in the top shelf and pass the cables from the balance controls through into the network compartment. Pull all excess cable into the

network compartment and caulk the holes with strips of felt.

Fasten A-61 and A-402 crossover networks, and the M-1131 intrarange equalizer, to the inside of the cover for the network compartment, using No. 8 by 1/2-inch R. H. wood screws. Orient the networks so that the terminal screws are all accessible. Drill a small hole through this cover for the 5460 input terminal strip and cable, connecting these leads to the A-61 crossover network. Connect the equalizer to the A-402 network, and the H-F cable from A-61 to A-402 crossover networks; the color-coded wiring diagram, Fig. 4, shows proper connections.

Next prop up the cover supporting the networks so that the leads inside the network compartment can be attached. Refer again to Fig. 4 for proper connections. Note that the black leads of the RP-302 and of the H-F balance control connect to terminal 4 of the A-402. Similarly, the green lead of the RP-201 and the black lead of the M-F balance control are connected to terminal 6 of the A-402. Splice the remaining leads of the RP-302 and RP-201 to the blue leads of the H-F and M-F balance controls respectively, using the splice nuts provided. Twist the wire ends tightly and fold them back on themselves, then simply screw on the splice nut tightly.

Now tip the cover into position over the compartment opening and screw it securely in place. Cut a slot about 1/2 by 1 in. in the center of the back cover of the cabinet; pass the input terminal strip through the slot and fasten it to the outside of the back cover with small wood screws. Fasten the back cover to the cabinet securely by means of wood screws on approximately 6-inch centers. Then listen!

POWER AMPLIFIER

Continued from page 27

and capacitors. Again, this is so that you can keep the wiring close to the chassis.

If there is any possible chance of a component's pigtail lead becoming shorted to some other lead or to ground, it should be protected by the hollow plastic covering called "spaghetti". This is sold in rolls and bundles of 8 or 36-inch lengths.

Every time you make a solder connection, examine it to ascertain that solder hasn't run down to the chassis, thus shorting that point to ground. And when soldering connections to phono pin jacks (and some types of octal sockets), tilt the chassis so that the solder can't run down into the pin receptacle.

Whenever you solder a component or wire in place, mark off that connection on the pictorial or schematic diagram. This will aid in spotting any omissions when you make a final check.

Before turning on the power shake the chassis vigorously at various angles, to loosen any stray pieces of metallic debris that could cause short circuits.

If you follow these suggestions, and make a final examination in which you look over every connection and cross-check it against the diagram, the amplifier should work properly the first time you apply power. If it doesn't, one of the tubes or components is likely to be defective—tough luck, and not your fault. In that case there are some tests that you can make without test equipment (see "Time For a Checkup", by Irving M. Fried, HIGH FIDELITY, July, 1954). And if these fail, take your amplifier with its schematic diagram to your local hi-fi service organization or, if there isn't one available, to a radio-TV serviceman you have confidence in.

BASIC ELECTRONICS

Continued from page 37

this electron flow, so that the amount of discharge was relatively slight. But why are metals good conductors and non-metals either poor conductors or insulators?

Again, the answer can be found in the atom's electron shell structure. Metals are elements having one, two, or three "extra" shell electrons, which are relatively free to be removed; insulators do not have such free electrons. Although conduction of electricity occurs at nearly the speed of light—186,000 miles per second—an electron doesn't travel through a conductor at that rate. The phenomenon is akin to that of a series of billiard balls loosely filling a tube; strike a ball at one end and it strikes the next with practically the same force; this strikes the next, and so on. Almost instantly after the first ball is struck, the ball at the opposite end shoots out of the tube; still, the other balls have moved only slightly. When a continuous source of electrons (such as the negative terminal of a battery) is connected to one end of a conductor, and a positive terminal is connected to the other end, the following events take place: electrons from the negative source, because of mutual repulsion, are forced into the end of the wire. These electrons repel in turn the free electrons in the conductor, sending them toward the other end, and they repel still others toward that end—just like the billiard balls. At the other end the positive terminal has attracted local free electrons, which have pulled other electrons along toward that end; you have one terminal pulling electrons and the other pushing them. The result is that the electrical current impulse is almost instantaneous, though it may be an appreciable length of time before a given electron makes its way through the conductor. And there you have elemental electrical current flow.

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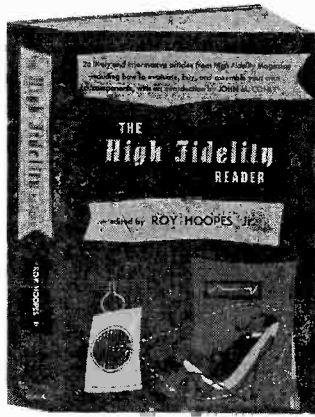
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TAPE NEWS

Continued from page 12

letter (made from that same tape) goes to someone in, say, Oklahoma City, who owns one of the original full-track (Fig. 1) machines, Oklahoma hits the roof and writes obscene letters to magazines, manufacturers, and tape correspondents. He, of course, has gotten a completely garbled horror consisting of remnants of Sydney's letter on the lower margin, Boise's letter on the lower half of the tape, Swarthmore's letter on the upper margin, and Oakland's letter on the upper half of the tape.

It is usually quite a simple matter to determine what type of head configuration your recorder has, simply by observing if the edges of the pole pieces are visible when the tape is lying across the heads. And we can reasonably make the following deductions from the accompanying figures:

An unused tape recorded on either head 1 or head 2 will play back satisfactorily on any other head. And an unused tape recorded on head 3 or head 4 will play back satisfactorily on either of those heads, and will play on 1 or 2, but at half volume and with slightly increased tape hiss.

However, the following rather involved relationships apply to re-use of previously recorded tapes: Head 1 will completely erase a tape made on any other head, so the resulting recording may be played on any other one. Head 2 leaves edge margins, so it will completely erase tapes made on 2 and 4. But if the original recording was made on 1 or 3, the re-recording from 2 will play satisfactorily on 2 or 4. If it is re-recording a tape made originally on 1 or 2, it will play only on 3 or 4. Head 4 will not completely erase tapes made on any of the other heads, so its re-recordings will play only on 4.

As for the binaural head configurations pictured in Figs. 5 and 6, the less said the better. While some machines do have staggered heads, it is highly unlikely that their tapes could be played on any other make of binaural recorder, so we shall quietly ignore Fig. 5. Head 6 seems to be the accepted thing for compatible binaural tapes, and tapes made on this head would play back on any similar binaural machine. Of course, if the tape had remnants of a previous program left on the margins, and the head on the other machine covered the tape right out to the edges, there would be trouble; but the reverse would not be true.

So there we are. Which raises a very good question: how to resolve this apparent morass of head incompatibility?

Simple, but slightly expensive. The obvious answer to it all, for those individuals who do much exchanging of tapes, is the purchase of a bulk eraser.

Typical of these handy devices are the Goodell "Noiseraser", and the "Magneraser" made by the Amplifier Corporation of America. Both these units will wipe every trace of recorded sound from a tape in a period of a few seconds, without unwinding the tape, and will reduce its hiss level to below that of a new tape.

Bulk erasers also find considerable use among those recordists who wouldn't even loan a tape to a friend, let alone mail it off to all corners of the world. For these users, bulk erasure eliminates the possibility of incomplete erasure, and does away with thunderous bursts of sound that often indicate a tape was stopped from time to time during a recording session, allowing just enough tape to coast past the heads, unerased, to preserve an occasional moment of brilliance from the previous recording.

So much for head incompatibility, which is enough to keep us occupied for a while. Meanwhile, there are still three other types of incompatibility which will be taken up at a later date. One of them is correctable . . . the others aren't, but they may help to explain why your best tapes are always being criticized by the correspondents who send you the worst tapes you've ever heard.

GROUNDING EAR

Continued from page 10

what many an audiophile has been asking for.

To me, the most interesting of the new tubes is the British EL84, miniature pentode in a 9-pin envelope capable of dissipating 12 watts. The most attractive characteristics of this tube are its extraordinary power sensitivity and efficiency. With 250 volts on both plate and screen a single EL84 will deliver 6 watts with less than 7.5 volts drive; a 6V6 will deliver only 6 with 12.5 volts drive, and the 6K6 needs nearly 18 volts drive to deliver 3.5 watts.

In many, if not most amplifiers, the driver distortion is probably higher than the output tube distortion. A bottle with such sensitivity therefore promises an amplifier with much less driver distortion and therefore less overall distortion. Furthermore, the lower the driving requirements the easier it is to reduce output impedance of a pentode by the use of local feedback loops—simple-series, partial cathode loading, Ultra-Linear—without forcing the driver into high distortion. So the EL84 presents all sorts of attractive and challenging possibilities and I wouldn't be one bit surprised if it produced a considerable revolution in commercial amplifiers of the 15-watt-and-under class. Amperex (the U. S. distributor) has a very complete booklet describing the tube and its applications and which includes a design for a 10-watt amplifier using the Mullard circuit.

The following ratings will summarize some of the tube's possibilities:

	One Tube	Two Tubes
Pl. volts	250	300
Scr. volts	250	300
Load	5,000 ohms	4,000 ohms
Output	6 watts	17 watts
Current	48-55 ma.	72-92 ma.
Drive	7.5 v. (peak)	14 v. per side

Output transformers suitable for the 6V6 and 6AQ5 will give good results until special transformers are available. Ultra-Linear operation calls for just about the same adjustment as given above for two tubes and the TO-310 transformer works fine.

The above comments on sensitivity apply to some degree to the Dutch 6CA7, also distributed by Amperex. It has a 25-watt dissipation and is contained in a glass envelope about the same size and shape as a metal 1614 or 6L6. As pentodes, a pair in class AB1 with 375 volts on the plates and the same on the screens (through a common resistor of 470 ohms), and a bias resistor of 130 ohms, will deliver 35 watts into a 3,400 ohm load with only 30 volts drive. This should be compared with nearly the same output for 35 volts drive in the case of KT66's. The superiority is more marked with triode operation, in which a pair will deliver 16.5 watts with 400 volts on the plates, cathode resistor of 220 ohms, and only 30 volts drive—as against 14.5 watts on 40 volts drive with KT66's. How well it compares with the KT66 in distortion characteristics I am not sure, though my results have been excellent and it appears better than the American equivalents of the KT66 . . . What with lower drive and somewhat more output the 6CA7 offers considerable promise as a replacement for 6L6's, 1614's, 5881's, etc., in Williamson amplifiers. It is not directly interchangeable. A jumper must be wired from pin 1 of the base to pin 8 in order to connect the suppressor to the cathode. Also, the biasing resistor will have to be changed—a value of around 150 ohms ought to be about right for the common portion of the biasing string in the Williamson. Though it needs a slightly higher load it works well with loads suitable for older tubes.

Ground Ripples

Apparently the 1955 audio shows will have the most notable novelties at the two ends of the reproducing chain—pickups and speaker systems. Pickering will have at least a prototype version of a new cartridge with response to 40,000 cycles. The German firm responsible for the Miracord changer has developed a back-to-back pair of variable reluctance cartridges in the medium price range with fine characteristics and the simplest, easiest mounting and needle change

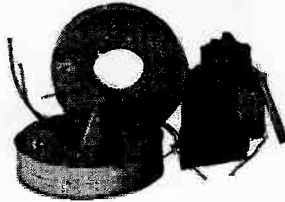
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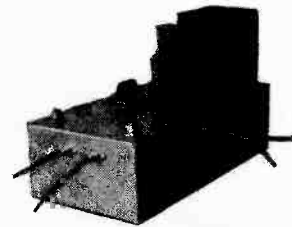
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GROUNDING EAR

Continued from preceding page

facilities yet. Fairchild is improving its very fine 220 and may have samples of the new models. Electro-Voice will have a new series of piezo-electric cartridges. Weathers will show a viscous-damped arm for its pick-up. EMI of Great Britain will show the Angel viscous-damped arm with a moving-coil cartridge.

There will be fierce competition in the most-bass-for-the-smallest-box stakes with Karlsen and Frazer-May, among others, presenting enclosures of about 1.5 cubic feet. Electrostatic speakers really worthy of the designation "high fidelity" will be offered, though the best will run into quite a bit of money. Maybe electrostatic woofers, too. Permoflux will have an acoustic echo box which they claim produces a high degree of stereophonic or 3D illusion. Two-channel stereophonic systems will make another commercial bow. Livingston will offer an inexpensive tape playback machine for stereo sound; Ampex will offer a handsome, complete stereo system using a simplified form of the 600 tape machine for playback and two furniture-cased 620 amplifiers. All in all, I'm sure the Fairs will prove that hi-fi is still far from the stagnation point.

FM IN YOUR CAR

Continued from page 32

bad capacitors on the voltage regulator, generator, and distributor; these should be kept in mind if trouble is experienced.



Fig. 8. Alford loop FM antenna on car.

A Mobile Antenna

An efficient antenna could be defined as one having sensitivity equivalent to a dipole, that is not of unreasonable size, that is horizontally polarized, and that is omnidirectional. An Alford loop meets these requirements. With a matching stub, moreover, a twin-lead line can be connected at any desired impedance. These antennas are described by Alford in

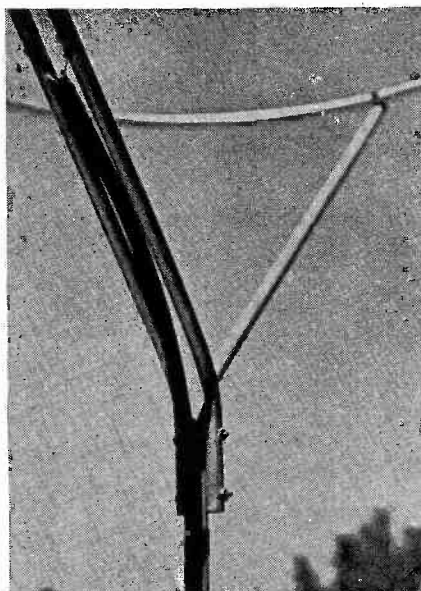


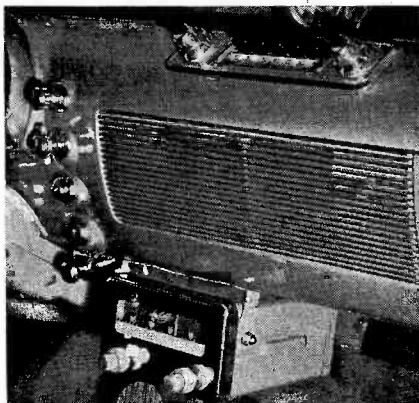
Fig. 9. Details of loop, pickup connection.

Trans. AIEE, 1940. An Alford loop on a car is conspicuous, Fig. 8, but striking in appearance and efficient.

To build one, a reasonable size is chosen and the length of stub required to resonate it at 100 mc. is found experimentally. Then this stub is built to support the loop, and the lead is tapped off at the point of maximum signal. The experimenting may be done with light rod, and the final antenna built of something more sturdy. The one pictured in Fig. 9 is constructed of 61ST6 dural 1/2-in. tubing, chosen for maximum strength. A metal-bending machine makes quick and neat work of the construction. The antenna is supported by a standard amateur mobile mount; additional support will most likely be needed under the body metal. The signal from such a loop antenna increases with its size, up to a half wave-length in diameter, so 2 1/2 ft. is a good compromise for mobile use. If one this size is constructed, no further experimenting will be necessary. The stub length is 22 in.

Two 12-ft. lengths of tube were purchased at nominal cost for the antenna. The lead-in is 225 or 300-ohm shielded twin lead—the shielding affords pro-

Fig. 10. Hastings FM tuner fits below dash



tection from ignition static, and serves to isolate the line from disturbances caused by its proximity with the frame of the car. The lead may be run through the body with connectors, or dressed through the trunk lid seam, and is run from the trunk under the floor mat to the firewall, thence to the tuner.

Those of slightly less adventurous bent will find the Hastings mobile FM tuners to be sensitive, compact, and relatively easy to install. Models are available for use with or without existing AM radios, and for 6 or 12-volt ignition systems. Small inside antennas are furnished, and complete installation instructions are provided. Fig. 10 shows one of these units. Address: Hastings Products, Inc., 171 Newberry Street, Boston 16, Mass.

SOUND SERVICING

Continued from page 15

tridge condition. Changer arms generally suffer more from stiff cartridges than do transcription arms.

5) Record quality deteriorates badly near ends of each record. Check through (3) again. Inner grooves accentuate all problems of tracking. In addition, you might try to change slightly the angle your cartridge makes with the side of its shell (or arm). You may be able to change it just enough to clear up some pernicious distortions. Try changing the angle both ways, in and out—you may be pleasantly surprised.

6) Record sound changes as records pile up. In a changer, both the angle of the stylus to the groove (in a fore and aft plane), and the stylus force on the record groove, change as the pile increases in height. First, you will want to make sure that, on the last record played, the body of the cartridge proper doesn't drag. If it does, you can either play fewer records at one time or change the cartridge angle. The stylus force changes too, particularly when a spring counterbalance is used. The remedy is to adjust for needle force on the middle record of a stack—better still, don't play a large stack, and adjust for proper needle force on the first or second record.

7) Record speed varies as records pile up. Check:

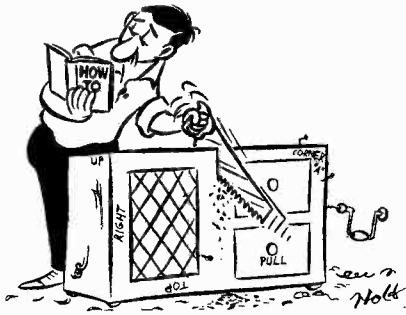
a Worn stylus, which digs into records at different angles, creating excess friction as stylus force increases.

b Warped records. If you must play them stacked, build up the center label with something like a strip of adhesive tape; the label will then grip adjacent records.

c The center bearing. A stack of records, being quite heavy, may cause too much friction. A clean, well-lubricated bearing will do a better job than a neglected one.

Continued on page 44

Audiophile's Bookshelf



EQUIPMENT

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SOUND SERVICING

Continued from page 42

These are some of the simpler problems that bother users of changers. Note that many of them are the same as those faced by your friend with the transcription turntable and arm. Certain of them, of course, are accentuated just because the changer motor, drive assembly, and arm must embody compromises for reasons of cost as well as because they must do double duty. However, you should be aware that a properly selected, set up, and maintained changer can be a very satisfactory method of playing high fidelity records for the great majority of record collectors. The more complex problems of the changer mechanism itself are another subject, to be treated at a later date.

WOODCRAFTER

Continued from page 16

cluding floor cabinets and built-in units for bookcases, closets, sideboards, etc. Such a list will, incidentally, arm the household handyman sufficiently to conquer most of the woodworking problems connected with home maintenance.

First on the list is a crosscut hand saw that will contribute to the ease and accuracy of cutting. Much of the stock you will work with will be $\frac{3}{4}$ in. thick,

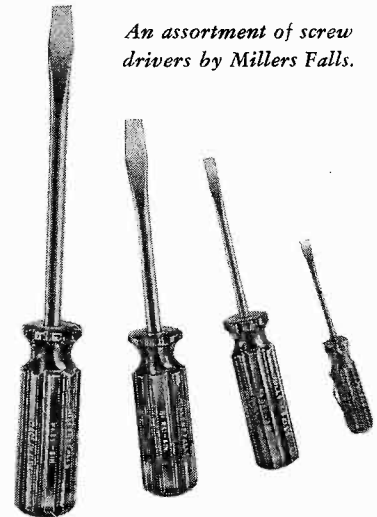
whether it is plywood or boards of hard or soft wood. Rarely will there be anything larger than 2 by 4-inch lumber to saw through and, if you choose a 26-inch crosscut saw with 8 tooth points to the inch, you will be more than adequately equipped.

Airtight, glued joints are of primary importance in speaker enclosures and a most valuable tool to accomplish a precision fit is the back saw. Unlike the flexible crosscut saw for the heavier work, the back saw is rigid and cuts with the accuracy and delicacy needed for perfectly fitted glued joints. A 12-inch back-saw with 14 points per inch is a practical buy.

While we're on the subject of saws, let's not forget the keyhole or compass saw. This is a narrow, tapering saw that lends itself to cutting speaker openings in baffles and to cutting curves elsewhere in thick pieces of wood. Keyhole saws come in many lengths—a 12-inch blade will more than suffice.

Now that you've stocked up on saws, let's decide on a hammer. I like to buy a hammer by feel. Pick it up, swing it—if it feels at home in your grasp, give it serious consideration. For your purposes a 12-ounce claw hammer seems a good choice. As a companion piece, include a nail set with a $\frac{1}{16}$ -inch tip to drive nails below the surface of the wood.

If you have never used a plane, you have a real thrill in store the first time the thin shavings rise in curls from the keen edge of the plane iron. It is a valuable instrument that can serve you well once you learn its mastery. There are several types, but a 12-inch jack plane will handle your average work very nicely.



An assortment of screwdrivers by Millers Falls.

Another important cutting tool is the wood chisel, which should be kept as sharp as a razor. Manufactured in many widths and shapes, a pair of socket chisels— $\frac{1}{4}$ -inch and $\frac{3}{4}$ -inch—will prove very versatile. And don't forget a wooden mallet or soft-faced plastic hammer to drive the chisels when necessary.

Since you have to keep the chisels and plane iron sharp you must include on your list a combination whetstone, with a coarse surface on one side and a fine surface on the other. When the lady of the house realizes that this is just the thing for her kitchen knives, you'll have something else to keep you busy.

Without a brace and an assortment of bits the average woodworking project would never get off the ground. A ratchet-type brace is the better investment, permitting a boring operation in tight quarters where a complete sweep of the frame isn't possible. Equip yourself with a set of bits in these diameters: $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, and 1 in. It would be wise to include a countersink bit to permit recessing flathead screws.

There will be many instances when holes smaller than $\frac{1}{4}$ -inch diameter will be needed for starting screws or for screw or bolt holes in removable panels. A hand drill is just the implement for this, and some come equipped with an assortment of drills. A half-dozen drills less than $\frac{1}{4}$ in. should answer most needs.

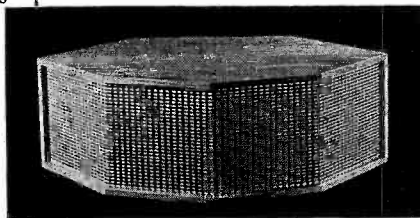
The glue and screw joints in hi-fi cabinet work assure the rigid construction so necessary. Therefore, the choice of screwdrivers is important. Select two

IT'S THE Janszen Push-Pull Electrostatic High Frequency Driver — THE FIRST LOUDSPEAKER THAT DOESN'T SOUND LIKE ONE.

The 'electrostatic revolution' is here . . . an instrument proven through 9 years of laboratory use in research—now available to you!

Obsoletes every conventional mid-range and high frequency tweeter with their inherent problems—cross-over, distortion, and lack of response. Has absolutely no coloration, shriek, or whine.

Reproduces perfect music, free from surface noise, etc., because of incredibly smooth response. Distortion UNDER 1% total harmonic at 50 Watts input!

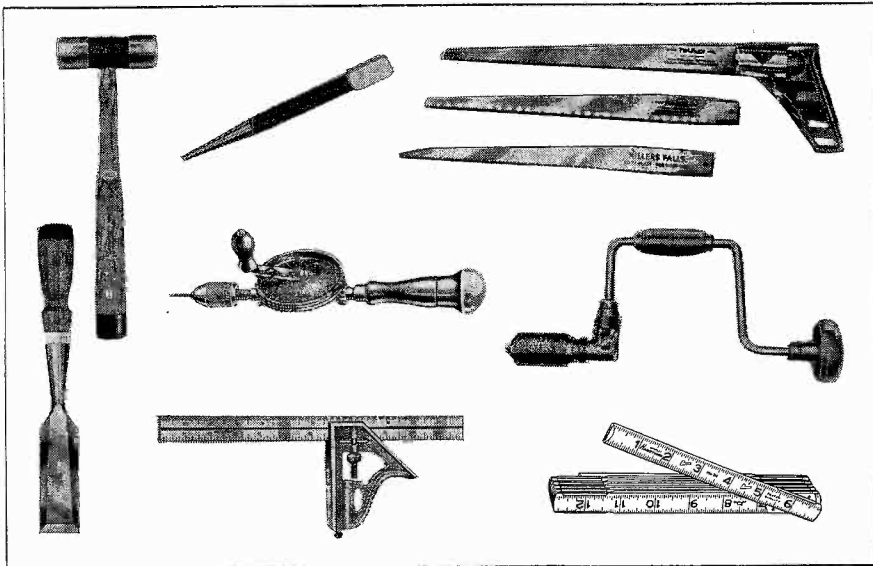


Janszen Model 1-30

— SPECIFICATIONS —

Frequency Response: 500-30,000 c/s.
Power Cord Input: 117 vs.-rms.-60 c/s.
Max. Sig. Input: 200 watts
(Under 1% distortion at 50 watts)
Dimensions: 12" x 21- $\frac{5}{8}$ " x 7-1/16"
(OA)
9" x 23" x 7-1/16"
(OA-Ut. Cab.)
Prices: Mahogany \$184.00
Birch 179.00
Utility 161.00

LECTRONICS CITY LINE CENTER Philadelphia 31, Pa.



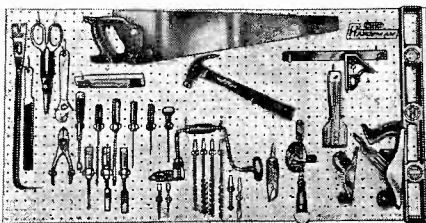
Chisel: Stanley; mallet: Stanley; nail set: Stanley; hand drill: Stanley; square: Stanley; keyhole saws: Millers Falls; brace: Millers Falls; folding rule: Stanley.

well-tempered, best quality screwdrivers — 4 and 6 in. in length.

Look over your dealer's stock of 6-foot folding rules graduated on both edges in 16ths of an inch. Choose your rule for ease of reading and strength of joints. All markings should be imbedded in the wood for permanency.

The last tool on this basic list is frequently the most important since it keeps check on the squareness of your work. It is the combination square with a built-in level; it serves as an inside and outside try square, mitre square, level, and plumb. The 12-inch blade is graduated on both edges.

No doubt some of the tools listed are already in your collection at home and in good, workable condition. The retail purchase price of all the tools is about \$40 for good quality. There are many excellent brands from which to choose.



Assortment of tools on board by Stanley.

Not all manufacturers make all the tools but here are some good names to look for: Stanley, Millers Falls, Disston (saws), Plumb (hammers), and Capewell (hammers). These are but a few of the many fine brands — talk it over with your hardware dealer and let him assist you in the selection.

Once you have acquired your new treasures, treat them as such. Use them only for the purposes they were intended for. Keep them in a dry place. Coating the metal parts with self-polishing liquid wax will help protect them against rust.

Protect the cutting edges of chisels, saws, drills, etc., from damage in storage as well as in use. Learn to sharpen tools correctly and your work will reflect better craftsmanship.

A workbench greatly facilitates woodworking. If you don't have one, it would make a wonderful first project to get acquainted with the tools. But even a make-shift workbench, such as an old table or a few planks stretched over sawhorses, will serve the purpose adequately on the simpler jobs. A piece of plywood or hardboard that amply covers the top of a kitchen table can transform that piece of furniture into a handy work surface — at least until another meal-time rolls around. If you decide on a regular workbench, be sure to include a woodworking vise — it's like another pair of hands in handling cumbersome pieces of wood.

There are many tools, both hand and power, that you can add as you add to your experience. But those we have discussed here will enable you to put your "do-it-yourself" ability to work producing examples of woodcraft that will make your hi-fi equipment more beautiful to look at and more satisfying to listen to.

AUDIONEWS

Continued from page 8

second new piece of equipment announced by Bogen. Specifications state that the HF8A has a usable power output of 10 watts, and 0.25% distortion at one watt listening level. Frequency response is specified as 30 to 20,000 cycles within 1 db.

The HF8A features a 3-position phonograph equalizer, a bass tone control providing for an 8 db boost at 50 cycles, and a treble control with 18 db

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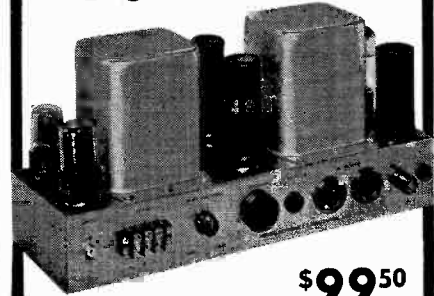
Exciting High Fidelity Firsts!

In these superb matched instruments—enjoy the foremost advances in High-Fidelity—startling realism—lowest distortion—precision craftsmanship—gleaming polished chromium chassis.

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Coronation 400

40 WATT AMPLIFIER



\$99.50

Greatest amplifier buy today! COMPLETELY NEW, NON-RINGING NEGATIVE FEEDBACK CIRCUITRY—over 50 DB feedback. CUSTOM CRAFTED—sealed transformers, encapsulated networks, finest molded components on Bakelite terminal board. DISTORTION-FREE—less than 0.05% at 30 watts. POWER RESPONSE ± 0.1 DB 16 to 35,000 cycles at 30 watts. Surpasses FCC requirements for FM broadcasting. 5 to 200,000 cycle response. 40 WATT WIDE-RANGE OUTPUT TRANSFORMER, sealed multiple section windings, thin strip core. FOOL-PROOF DAMPING CONTROL for startling speaker performance. BUILT-IN POWER for preamplifiers and newest electrostatic tweeters.

INTERELECTRONICS

Coronation 85

CONSOLETTA PREAMPLIFIER-EQUALIZER



\$79.50

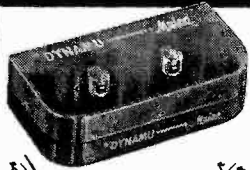
Incomparable companion to the "CORONATION 400". EXCLUSIVE NEGATIVE FEEDBACK CIRCUITRY. Over 50 DB—virtually eliminates distortion. Surpasses FCC requirements for FM Broadcasting. 5 to 200,000 cycle response. CUSTOM CRAFTED—polished chromium chassis, satin gold front panel. Encapsulated precision networks, molded components on Bakelite panel. LOUDNESS CONTROL, continuously variable. FIVE INPUT SELECTIONS, 16 PRECISION PLAYBACK CURVES. FULL 20 DB DISTORTION-FREE Bass and Treble compensation. Phenomenal lowest noise Z-729 input tube HUM IN-AUDIBLE with all controls on full. Highest gain. Built-in power for motion picture photo-cells, FM phono cartridges, condenser micro-phones. Ultra compact, easy front mounting.

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Maico Bldg., Minneapolis, Minn.

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For the first time—the complete story of the phonograph; its invention and development. As one of this country's outstanding music critics, the author has a keen appreciation of the phonograph's aesthetic role—and as a historian he traces the phonograph's development from Thomas Edison's curious tin-foil apparatus to the astounding high fidelity sound systems of today.

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Please send me, by return mail, a copy of "The Fabulous Phonograph." \$4.95 enclosed. sorry, no C.O.D.'s.

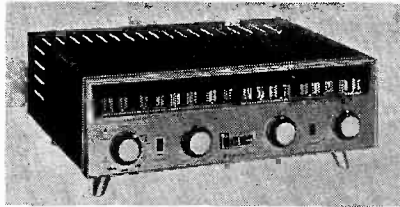
NAME

ADDRESS

AUDIONEWS

Continued from preceding page

attenuation at 10,000 cycles. Price of the unit is \$39.99.



Bogen RR550 Receiver.

Staticmaster System

The "Staticmaster" System was conceived to meet the needs of broadcasting stations where it is not always possible to take the time to brush records thoroughly before use. Many audiophiles will be interested in this system which can be used where records are played on a turntable or individually on a changer.

The System consists of a standard "Staticmaster" Record Brush plus a special ionizing unit mounted on a flexible chrome arm.



Staticmaster System.

The "Staticmaster" System sells complete for \$39.00, or, if the "Staticmaster" Record Brush has already been acquired, the balance of the System is available for \$21.25.

The effective life of the System is up to two years and carries a one-year unconditional guarantee. Polonium elements used in the Record Brush and Ionizing Unit can be replaced.

"Staticmasters" are manufactured by Nuclear Products Company, 10173 E. Rush St., El Monte, Calif.

Collaro RC-54 in Four New Units

The Collaro RC-54 record changers are now available in 4 new units, all furnished with power cords and audio connecting cables. The units need only be plugged in to be ready for use. "C" Series units are supplied with oversized, laminated, 3/8-inch, pre-cut mounting boards. These boards are sanded smooth to take any finish. The "M" and "B" Series units are supplied with hardwood bases—"M" for mahogany and "B" for blond. The units in the latter series are adapted to table-top or open-shelf use. Designations and prices for the new units are as follows:

Series 540-C with Collaro Studio O

Dual Sapphire Crystal Cartridge—\$56.00

Series 541-C with GE Variable Reluctance Dual Sapphire Cartridge—\$60.00.

Series 540-M or B with Collaro Studio O Dual Sapphire Crystal Cartridge—\$60.00.

Series 541-M or B with GE Variable Reluctance Dual Sapphire Cartridge—\$64.00.

Cartridges are mounted in interchangeable plug-in shells which accommodate all standard cartridge makes.



*Collaro—Series B
Model RC-54 on Blond Base.*

For further information, write to Rockbar Corp., 215 East 37th St., New York 16, N. Y., Att: Mr. Mort Wimpie.

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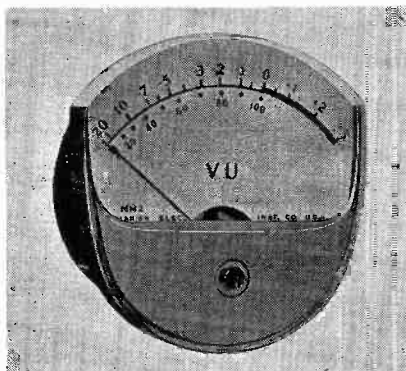
CALL KIERULFF SOUND CORPORATION, 820 West Olympic Blvd., Los Angeles (RI. 7-0271) for all your Hi-Fi component requirements. As the largest Parts Jobbers on the Pacific Coast, we have a complete stock of all accessories as listed and advertised in **AUDIOCRAFT**. Introductory Offer: 1 roll of Recorded Tape **FREE** when you come in and mention that you are a reader of **AUDIOCRAFT**.

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New Marion Medalist VU Meter

A new VU meter has just been developed as part of the recently introduced Marion Medalist line of panel instruments. Designed for precise indication and measurement of audio frequency voltages in broadcast, monitoring, recording, and hi-fi applications, the new



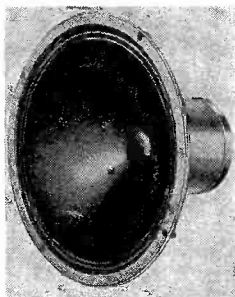
Marion Medalist VU Meter.

Medalist VU meter meets the latest A.S.A. specification C16.5-1954 for Volume Measurements of Electrical Speech and Program Waves. Complete technical data on the MM2VU meter are available from the manufacturer, Marion Electrical Instrument Company, Manchester, N. H.

New Goodmans Loudspeakers

Goodmans Loudspeakers has announced a new line of speakers designed particularly for public address and industrial applications, electronic organs, and as bass reproducers in 2- or 3-way high fidelity speaker systems.

Audiom Loudspeakers, as they are called, come in the following models: *Audiom 90*, 18 in. in diameter, 50 watts. Types may be selected with fundamental resonances of either 35 or 50 cycles.



Audiom 70.

Audiom 80, 15 in. in diameter, 25 watts, has interchangeable cones and may be had with a fundamental resonance of either 60 or 40 cycles.

Audiom 70, 12 in. in diameter, 20 watts. Available in two cone types: 75-

Continued on next page

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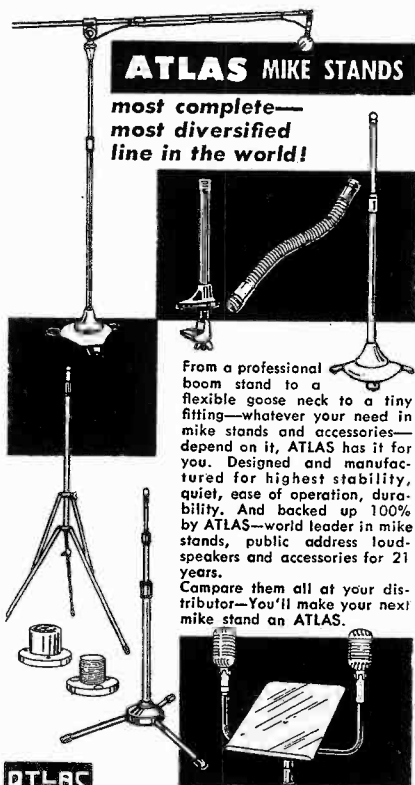
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ATLAS SOUND CORP.
 1444-39th Street, Brooklyn 18, New York
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How to fix record changers ...
quickly, easily!



Even if you never changed a needle before, you can make speedy, expert record changer repairs—with the aid of this new simple guide! It shows exactly how a record changer works, what is likely to go wrong, how to find the trouble, and how to put it right.

REPAIRING RECORD CHANGERS

By E. Eugene Ecklund
 Head, Special Products Engineering Section,
 Instrument Division, Allen B. DuMont Labs., Inc.
 278 pages, 6 x 9, 202 illus., \$5.95

In plain language—no math or theory—the book takes you step by step through record changer and magnetic tape recorder action. Motors, drives, tripping mechanisms, and record dropping mechanisms are fully covered. You're shown how to spot and repair troubles quickly and successfully. Clear sketches and diagrams are based on popular models so you easily recognize parts when doing actual repairs.

Book Dept., Audiocraft Magazine
 Great Barrington, Mass.

AUDIONEWS

Continued from preceding page

cycle fundamental resonance for public address systems and 35-cycle fundamental resonance for high fidelity bass reproduction in multi-speaker systems. *Audiom 60*, 12 in. in diameter, 15 watts. Recommended in applications where excessive power capacity is not required. Available in three cone types with the following resonances: 35 cycles, 55 cycles, and 75 cycles.

For further information, write to Rockbar Corporation, 215 East 37th St., New York 16, N. Y.

Sherwood 3-way Speaker System

The "Forester", a new 3-way speaker system, has been announced by Sherwood Electrical Laboratories. The unit consists of three specially designed speakers (12, 8, and 5-inch) in a 5½-foot, curled-horn cabinet.

The individual speakers and the 300, 5,000 cps 12 db/octave crossover are available in separate "Do-It-Yourself" kits for modernizing existing systems or for building new installations. Various cabinet styles are offered, including blond "Contemporary", mahogany "Traditional" with gold-tooled leatherette top, and "French Provincial". These systems are manufactured by Sherwood Electronics Laboratories, Inc., 2802 W. Cullom Ave., Chicago, Ill.



Knight FM - AM "Bantam" Tuner

Allied Radio Corporation announces the release of a low cost FM-AM tuner. A "basic" tuner, it has only 2 front panel controls: Tuning and Function Selector. A third control, Output Level, is located on the rear panel.

The tuner has 7 tubes plus rectifier. Sensivity on FM is said to be 5 microvolts for 20 db quieting; AM sensitivity, 20 microvolts for 1 volt output. Frequency response is stated as 20 to 20,000 cycles, ±0.5 db. The Function Selector provides selection of AM reception, and FM reception with and without automatic frequency control.

The unit is housed in a 3½ by 11½ by 9¼-inch deep metal cabinet with cork-grain finish and removable, gold-finished escutcheon. The "Bantam" tuner is priced at \$62.95 and is listed under Allied Stock No. 94 SX 703. For additional information and complete specifications, write to Allied Radio Corp., 100 North Western Ave., Chicago 80, Ill.



PHOTOGRAPH BY RICHARD BEATTIE

What are the facts about cancer of the lung—?

JUST 20 YEARS AGO, in 1933, cancer of the lung killed 2,252 American men. Last year, it killed some 18,500.

WHY THIS STARTLING INCREASE? Our researchers are finding the answers as rapidly as funds and facilities permit—but there isn't enough money.

DOCTORS ESTIMATE that 50% of all men who develop lung cancer could be cured if treated in time. But we are actually saving only 5% . . . just one-tenth as many as we should.

WHY—? Many reasons. But one of the most important is not enough money . . . for mobile X-ray units, for diagnosis and treatment facilities, for training technicians and physicians.

THESE ARE JUST A FEW of the reasons why you should contribute generously to the American Cancer Society. Won't you please do it now? Your donation is needed—and urgently needed—for the fight against cancer is everybody's fight.

Cancer MAN'S CRUELEST ENEMY Strike back—Give

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Please send me free information on cancer.

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