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AUGUST
1958
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(See Pages 29 and 32)

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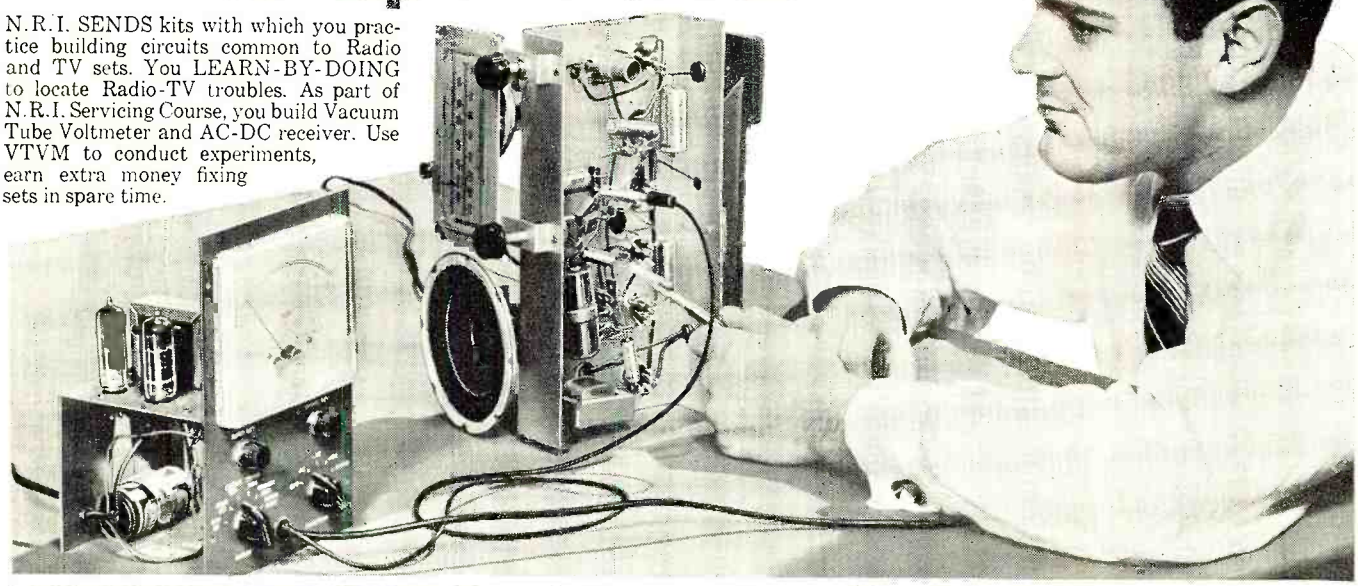

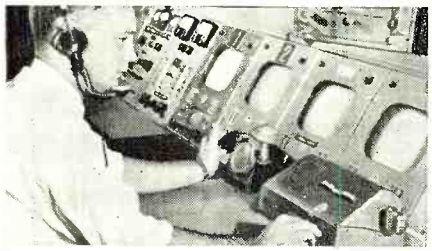

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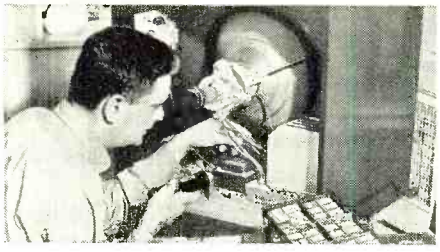

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CONTENTS

AUGUST, 1958 **VOL. 60 ■ NO. 2**

ELECTRONICS—GENERAL

HIGH FIDELITY AND AUDIO

TELEVISION-RADIO

AMATEUR AND COMMUNICATIONS

ELECTRONIC CONSTRUCTION

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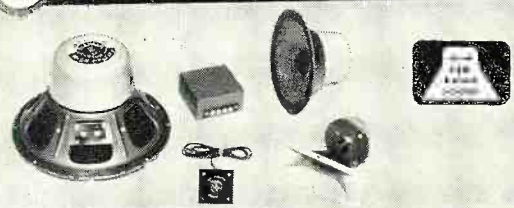

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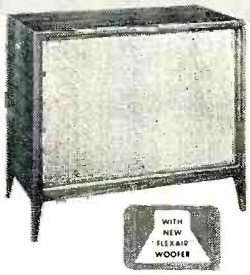

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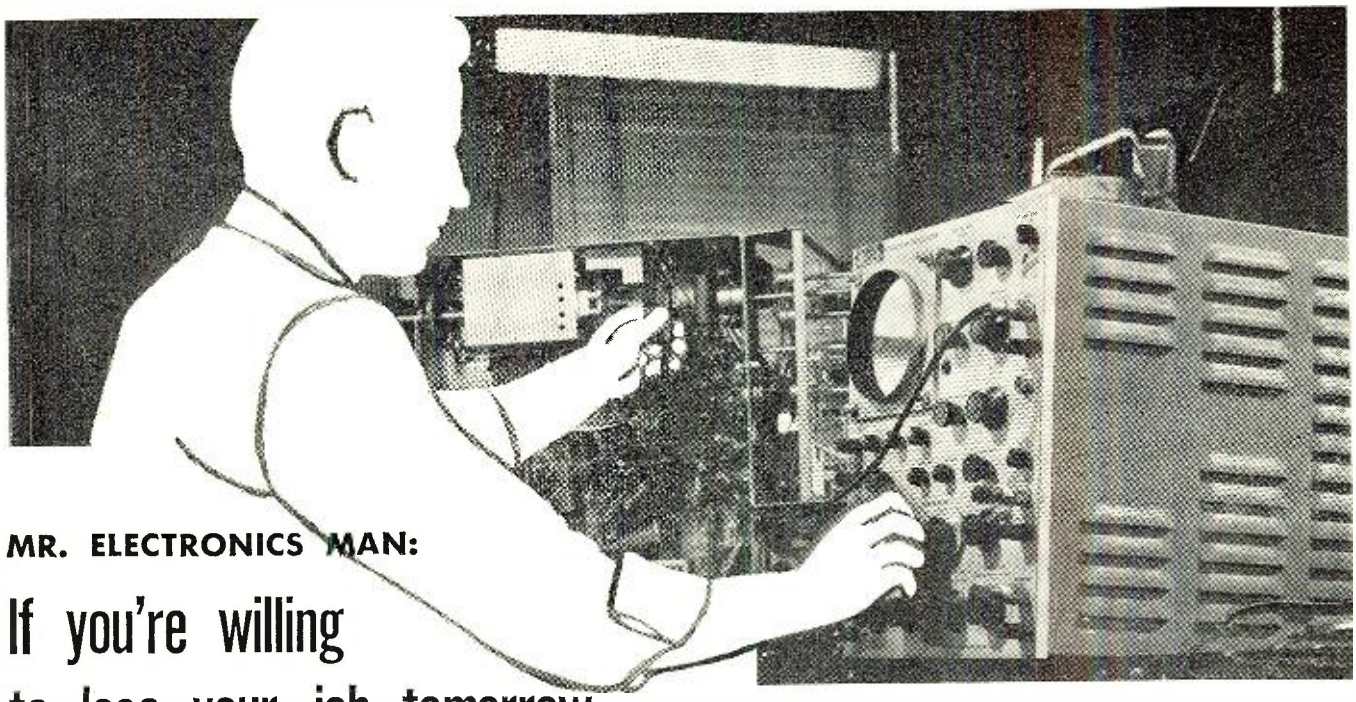

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...for the Record

By **W. STOCKLIN**
Editor

STEREO BOOM AHEAD

STEREO, stereo, stereo! No matter where we turn or where we go "stereo" seems to be the main topic of conversation with everyone we meet in the industry. In fact, even the recent Electronics Parts Show in Chicago, which in the past was more for the radio and TV parts manufacturer, turned into a high-fidelity show with stereo uppermost in everyone's mind. The stereo disc, which was announced just a short time ago, is setting the stage for one of the greatest boom periods that the industry has ever seen or, from where we sit, will see for a long time to come. The period directly following the announcement of the LP disc some ten years ago saw a marketing boom which was tremendous at the time but may seem insignificant when compared to the period now in prospect.

As an example, *RCA* is looking ahead to this stereo market to such a degree that, with the exception of two hold-over phonos, its entire Fall line of packaged equipment (which includes phonographs ranging in price from $129.95 to $2500.00), will all be stereo-monaural units. *Zenith Radio Corporation's* high-fidelity line will include 37 record players—again, all capable of handling both types of records. These are only two companies. We're sure that every manufacturer producing high-fidelity equipment is gearing himself for the stereo market to come. We have never implied in the past that an inexpensive, packaged phonograph can give you the best reproduction, either monaural or stereo, and we do not want to convey such an impression now. However, pointing out what some of the manufacturers are planning gives one an idea of what to look for in the future.

As far as the discs themselves are concerned, *RCA* will have approximately 81 releases, including both classical and pop, available for the August market. There are some four or five other disc manufacturers who are making stereo records and, in many cases, such releases are already available in the larger record shops. We are sure that *Mercury, Columbia, London, Decca,* and others will join the bandwagon and make stereo discs available to the general public.

For the consumer this means new equipment for the most part, or additional components to round out his system for stereo operation. One of the biggest problems in making a conversion to stereo discs is the turntable or changer. The installation of the stereo cartridge needed is not too difficult a task. It would mean simply rewiring to accommodate three or four lead connections, depending upon which stereo cartridge is used.

Regular monaural records do not make use of a vertical groove motion and the monaural cartridges commonly used are not sensitive to this type of motion, hence turntables and record changers which have vertical flutter and rumble components can be used with regular monaural cartridges. However, with the new *Westrex* 45-45 system, which relies on a vertical groove motion to obtain part of its signal, many record players and especially changers, with the exception of the best quality units, may produce excessive rumble and flutter. *RCA,* for example, will market a conversion kit which will consist of a cartridge, tone arm, *motor,* and mounting plate.

It will be a difficult decision for most individuals not familiar with the technical aspects of high-fidelity to determine whether a new phono turntable or changer is required or if a simple cartridge conversion is all that is needed. Ordinary turntables, if they are of relatively good quality, would for the most part work out satisfactorily. Record changers, on the other hand, unless they are of the highest quality, would most likely present difficulties. If there is any doubt, your local service technician or someone from your local audio salon should be qualified to advise you.

Stereo Tape

Another audio bombshell was dropped recently and this pertains to stereo tape. *Ampex* has just announced a four-track head to be used with some of its newer machines, plus a conversion kit to adapt the firm's tape units already in the hands of the public to this mode of operation.

RCA has also announced a four-track assembly for use with a tape cartridge. This new cartridge will provide as much playing time as a regular LP record and retail at prices ranging from $4.95 to $9.95 depending on playing time and program. The cartridge itself is simply slipped into the machine which then takes over to play the tape. The unit automatically stops the tape after the first play-through and then reverses the tape for completion of the second half. This is a revolutionary development in the tape industry and destined to have a tremendous impact on the future market. For further details on *RCA's* and *Ampex's* four-track tapes, see pages 80 and 104 of this issue. —30—

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How far can you go in electronics without a degree?

A few years ago, Lincoln E. Kitchin had no formal degree and knew nothing about electronic computers.

He still doesn't have a degree, yet today, he is a Field Engineer on one of America's biggest electronics projects. He helps maintain one of the largest computers in the world. He's doing work ordinarily done by engineers—an opportunity usually denied to men without a degree. This is a story of unusual significance to every technician who feels himself handicapped by lack of a formal degree.

"It all started back at the Base," Link recalls, "about two years ago. We were having lunch. One of my fellow Aircrewmen described an interview he had just had—with IBM.

"It sounded good to me—particularly the field engineering aspects. I wasn't anxious to start my civilian electronics career stuck in a corner of some plant. Here was a chance to work in the field—with all the advantages of a permanent location. I made a note to add IBM to the companies I was considering for civilian work."

Taking notes in IBM Field Engineering class | Discussing a SAGE display console | Front view of computer frame

Interviewed by IBM

A month later, Link sat across the desk from an IBM interviewer. "Frankly," confesses Link, "I was scared at the thought of this interview. I didn't know the difference between an analog and a digital computer. I didn't expect to get the job."

The interviewer put Link quickly at his ease. A check of his background revealed Link's Service training—28 weeks of Class "A" aviation electronics plus Class "C" schooling in LORAN, RADAR and SONAR. He took a test, which indicated excellent aptitude for computer work.

Then Link learned how IBM would train him in electronics—for five months at full salary—to become a Field Engineer on the SAGE Program. He learned about SAGE, part of our nation's radar defense net, which is built around giant IBM computers—each containing 50,000 vacuum tubes plus 170,000 diodes. He heard about IBM's excellent company benefits, especially interesting to Link who had a wife and child. By the time the interview was over, Link had decided that IBM and the SAGE Program were what he was looking for. He decided then and there that he wanted to come with IBM.

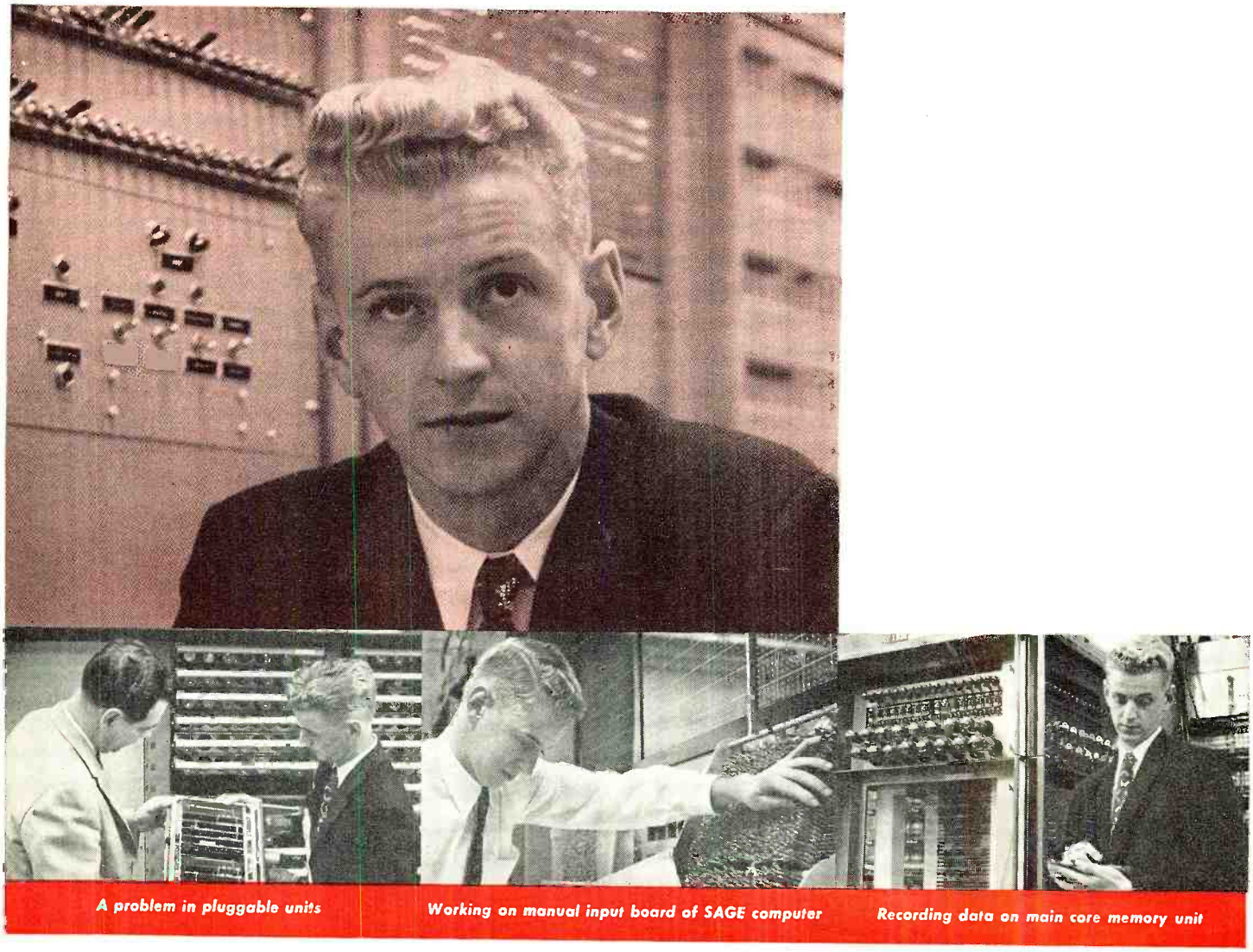
Receives 20 weeks' training

Link reported to Kingston, N. Y., for training. In the IBM "school," he studied basic computer circuits, computer logic and programming, card punch machines—all part of the twenty-week course a Computer Units Field Engineer takes. "The instruction was excellent," he recalls. "Our teachers, experienced field men, often made points not in the textbooks." Formal classroom lectures accounted for half his time, the other half being spent in the laboratories, where he worked on actual computer equipment for SAGE. During his training period, Link received a living allowance in addition to his salary.

Assigned to site in home state

His twenty weeks' training completed, Link was assigned to the SAGE site at Topsham, Maine. "IBM makes every effort to assign you to a location of your choice wherever possible," Link, who is a native State-o'-Mainer, points out.

At Topsham, Link has completed the installation phase of the computer. Now, his work consists of preventive maintenance and "keeping the customer happy"—the customer, in this case, being the Air Force personnel who man and operate the computer. "Installing this giant computer was a significant engineering feat," Link recalls. "First we ran 2,509 cables from 4 to 300 feet long. Then we bolted the computer sections together and hooked up the cables. Next came the testing phase in anticipation of Air Force acceptance tests.



A problem in pluggable units | Working on manual input board of SAGE computer | Recording data on main core memory unit

"I'm in the Display Group," Link continues, "which has responsibility for over one hundred display consoles. Each of these has a 19-inch and a 5-inch cathode ray tube (similar to a TV tube) plus associated circuits. The knowledge of complex circuitry which we learned in the IBM school is essential for this work. We also maintain our own test equipment—oscilloscopes, meters, signal generators and specially designed pluggable unit test equipment."

What does the future hold?

Link looks forward to a rewarding career as a Computer Units Field Engineer. Promotion-wise, he could become, with further training, a Computer Systems Field Engineer, a Group Supervisor or Group Manager. Most important, however, he believes, is the excellent electronics background he's acquiring for the years ahead. "I've had a new engineering dimension added to my career—thanks to IBM's willingness to spend time and money training technicians to assume engineering responsibilities."

A career for you with IBM?

Since Link Kitchin joined IBM and the SAGE Program, opportunities are more promising than ever. This long-range program is destined for increasing national importance and IBM will invest thousands of dollars in the right men to insure its success.

If you have a minimum of three years' education or experience in electronics—gained through technical schooling or military service—you may qualify to become a member of this important, permanent, expanding program as a Computer Units Field Engineer.

You'll receive twenty weeks' advanced computer training at Kingston, N. Y., with full pay, plus living allowance, before assignment to a permanent location. Current openings are in the Great Lakes area and in the Pacific Northwest—and will be filled in the fall, 1958. You'll receive salary, not wages. And, of course, you'll receive IBM's famous company-paid benefits.

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OUR APRIL ISSUE

To the Editors:

Your April issue happened to be very interesting to me. I am no audiophile and my interest runs to constructing test equipment. The article on using the TV picture tube as a scope was particularly intriguing since I have a science teacher friend who asked about converting a TV set for just that purpose. Also, I have the *Heath* linearity checker, and the article on the rainbow generator was good meat and drink on a rainy spring night.

I think John Frye's articles with Mac and Barney are excellent, not only because they are sugar-coated expositions of useful explanations, but because he goes beyond the usual coverage and gives little sidelights on the topics that one only gets from person-to-person discussions.

One other thing. Along with many others, I have the problem of using a perfectly good tube tester for the very latest tubes, for which no data has yet been published. Perhaps you can come to our rescue by writing an article on how to determine the settings for new tubes from the published characteristics, or perhaps you have something else to suggest.

J. J. Bobrow
Hollis, New York

Thanks for your plaudits and many more we haven't the space to run. We agree that "Mac's Service Shop" is pretty terrific. On the tube tester problem, we are planning some help for you along these lines.—Editors.

* * *

WHAT IS TRUE STEREO?

To the Editors:

Of late, we have been bombarded with all kinds of stereo claims. It seems that just about everything is stereo these days. We have been told that echo devices, dual high-frequency —low-frequency amplifiers, and simply the use of two separated speakers can give us stereo, even if we start out with a single monaural program source. Now just how are we poor readers to know what is and what is not true stereo?

Richard Irwin
Elmhurst, New York

Exactly the same thing is happening to the term "stereo" that has happened to the term "hi-fi." Every phonograph producing an audible sound these days seems to be referred to as a "hi-fi" unit. Similarly, we are beginning to see the use of the term "stereo" applied to any system employing two separated speakers, regardless of whether two separate stereophonically recorded program channels were used. Insofar as we are concerned, true stereo reproduction requires two such channels.

Now this is not to say that some type of stereophonic effect could not be produced by some of the other methods mentioned by our readers. These frequently do result in an improvement over ordinary single speaker reproduction. But, at best, these systems simply produce a spread in the sound rather than the true directivity that a full stereo system is capable of. It might be well to say that these systems produce a "pseudo-stereo" or a "semi-stereo" effect.—Editors.

* * *

"MAC'S SERVICE SHOP"

To the Editors:

I have had lots of inquiries about the receiver mentioned in "Mac's Service Shop" for April. The receiver described is a *Korting* Model 1030. It is imported by *Delmonico International*, 42-24 Orchard Street, Long Island City, New York. By writing to them, you can doubtless obtain further technical information and possibly the name of a dealer near you. Please note I am not trying to "sell" these sets. I am impressed by their quality, but there is always the problem of obtaining replacement parts, service, etc. Look into that angle and try one out yourself before buying.

John T. Frye
"Mac's Service Shop"
Logansport, Indiana

* * *

MOBILE RADIO

To the Editors:

Regarding your article "Basic Facts on Mobile Radio" in the April issue, this is to advise you that the 50 to 54 mc. band is not available for commercial use since this is the amateur 6-meter band. In view of what the amateur has had to face in the past in trying to retain a few hard-earned kilocycles, please don't take away any more of our spectrum.

Ed Breland
Laurel, Mississippi

Author Lytel was certainly not trying to take away any of the hams' bands when he gave the frequencies used by the Mobile service. Instead, he was simply giving an approximate frequency range used. What is more, some of the commercial mobile receivers do cover a portion of the ham bands that skirt the commercial frequencies, although the transmitters

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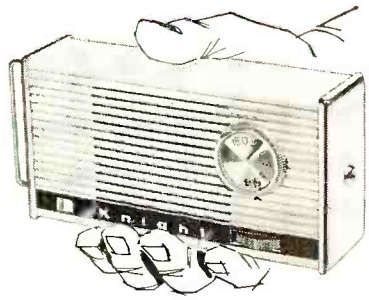

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certainly do not. Your editor, who also happens to be a ham, can sympathize with Reader Breland's comments.—Editors.

* * *

MULTIPURPOSE HAM ACCESSORY

To the Editors:

Correspondence with readers concerning the "Multipurpose Ham Accessory," which I described in the February, 1958 issue, has indicated that some have been troubled with a low audio output level. The unit described in my article actually should have enough audio output to be easily heard in the average living room, for I use mine to conduct code classes for groups of about fifteen individuals. The wiring diagram was correct as it appeared in RADIO & TV NEWS.

However, it might have been better to connect capacitor C_3 directly to the plate of the previous tube instead of to the tap on potentiometer R_4. This ought to boost the audio output appreciably.

RALPH W. MYERHOLTZ, JR.
Highland, Indiana

We certainly go along with the author's suggestion in this regard. With the resistance of R_4 all the way in, the large resistance of 5 megohms would certainly cut down on signals going through C_3.—Editors.

* * *

TAPE-RECORDER WOW

To the Editors:

I have had some lengthy correspondence concerning my article on wow and flutter measurement, which appeared in the January, 1958 issue. Although I can appreciate the work and effort that went into some of the comments and mathematical analysis, I would like to clarify the following points:

1. A comment was made that the definition quoted in the article for per-cent wow and flutter was not in agreement with the IRE definition. It is true that the latter definition is more specific in that the deviation is stated as being an r.m.s. amount while my definition did not so specify. The fact is, however, that not all manufacturers are using the IRE definition. I was aware of this fact and it was for this reason that the initial formula does not specify whether the deviation is r.m.s., peak, average, or otherwise.

2. A second point was made concerning what was believed to be a fundamental fallacy in the method of measurement due to the fact that the recording and playback processes are mechanically linked together. The accepted method of measuring wow in any recording is to first make the recording and then play it back. This is the basis not only of the method described in the article, but is also the basis of all commercially used and accepted methods of measuring wow.

3. One final point concerns the formula used on page 41 of the article, which gave the percentage of wow. This formula should be revised so as to employ the *average deviation*. This

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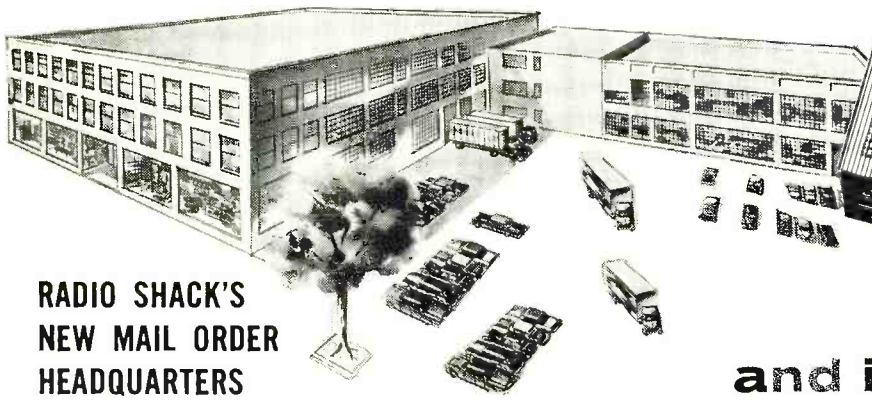

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will make the formula read as follows: Per-cent wow is equal to 100 times the tape speed (ips) divided by *four* times the recorded frequency times the distance between heads (inches). This will halve the wow percentage obtained by the formula in the article.

RICHARD GRAHAM
Allendale, New Jersey

Thanks to Author Graham for the above comments. The method described was not meant to be a laboratory-accurate system, but it is actually a "poor man's version" of the system used in some commercial wow meters. As a matter of fact, it is the method commonly used before the advent of direct-reading wow meters. Our thanks also to readers Donald Savage and John Griffiths for their comments and analysis of Mr. Graham's method. —Editors.

* * *

ZERO CLIPPER

To the Editors:

Many readers have inquired about the .1-μfd. capacitor on the "Zero Clipper" mounting board (May, 1958 issue). One side of this capacitor goes to ground. The other side connects to the junction of the 100,000-ohm resistor and the 2-megohm potentiometer.

The capacitor is optional. With the capacitor out of the circuit (as in the schematic diagram), turning the pot changes the volume as well as changing the bias on the diodes. With the capacitor in the circuit, moving the pot will no longer change the volume when it changes the diode bias, but this is obtained at the expense of a somewhat higher attenuation when the clipper is used in the audio circuit of a receiver.

HECTOR E. FRENCH
Sanborn Company
Waltham, Massachusetts

The capacitor was not shown in the circuit, as this produced a device that resulted in greater gain in the receiver with which the clipper is used.—Editors.

* * *

SATELLITE DOPPLER EFFECT

To the Editors:

As most everyone knows, the Doppler effect ("Receiving 'Explorer's' Radio Signals," May, 1958) is caused not by a change in the velocity of propagation, but rather by a change in the radial velocity of the transmitter relative to the receiver.

Also, as any junior space cadet can quickly calculate, the Doppler shift on a 200 mc. signal at 90,000 m.p.h. will be only about 27 kc., and not 50 mc., as was indicated in the article.

ROBERT S. DUGGAN, JR., W4MIA
Atlanta, Georgia

Reader Duggan and many others who pointed this error out to us are right. The correct answer should have been ± 27 kc. for a total shift of about 50 kc. rather than 50 mc. Sorry for the typographical error.—Editors.

—30—

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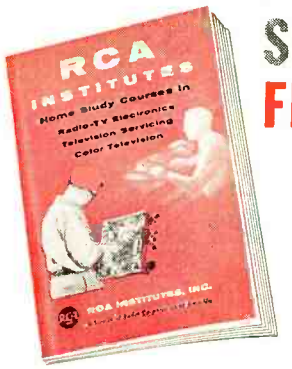

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Wi hin the Industry

JOHN T. THOMPSON has been appointed manager of the newly formed distributor products division of *Raytheon Manufacturing Company.*

This new division will have full responsibility for marketing all of the firm's components sold to electronic parts distributors and which are produced by five of its seven manufacturing divisions.

Prior to his new appointment Mr. Thompson was associated with *General Electric Company* as manager of distributor sales for its electronic components division since 1950. He joined the firm in 1939.

Mr. Thompson is a graduate of the University of Michigan with a B.A. degree.

* * *

LEONARD G. WALKER, marketing manager, microwave and industrial control department, *Motorola, Inc.,* has been appointed chairman of the microwave section, Electronic Industries Association technical products division.

Mr. Walker succeeds Maury G. Staton, who resigned following a change in his position with *RCA.* Walker joined *Motorola Inc.* in 1951 after a fifteen year affiliation with the *Idaho Power Co.* as an electrical engineer.

* * *

GEORGE D. BUTLER has joined *International Resistance Company* as sales director of the firm.

In his new position Mr. Butler will be responsible for sales direction of all of the firm's plants in addition to other responsibilities.

He received his B.S. degree at Princeton University and has been a technical representative for *Bendix Aviation Corp.,* a senior engineer with *Carl L. Norden, Inc.,* a physicist with *American Cyanamid Co.,* and district sales manager for *Beckman Instruments, Inc.*

Mr. Butler was also vice-president, director, and general sales manager of *Warren Electronics* and was director of sales for *Norden Ketay Corp.* until his new appointment.

* * *

SYMPHONIC ELECTRONIC CORPORATION announces that the majority control of its stock has been acquired by **F. L. JACOBS CO.** of Detroit. No change in the present management of the company is contemplated . . . **GENERAL INSTRUMENT CORP.** has formed a special division for new product development. It will be headed by Lawrence R. Hill as divisional manager . . . **SERVOMECHANISMS, INC.** has consolidated its two West Coast component divisions into a single unit to be known as the special products division. Constituting the new unit are the facilities of the former magnetic division at Hawthorne, Calif. and the former vacuum film products division at El Segundo. Both plants will continue in production and personnel remains intact but sales and administrative functions are now centralized at 1000 El Segundo Blvd., Hawthorne, Calif. . . . **NARDA ULTRASONICS CORP.** has acquired **ALCAR INSTRUMENTS INC.** The subsidiary will be operated as an independent division with production and research activities being continued at the plant in Little Ferry, N. J. under the same management as before. The sales offices, however, will be moved to the parent company's headquarters at 118-160 Herricks Road, Mineola, L. I., N. Y.

* * *

GORDON E. BURNS has been appointed distributor sales manager for *General Electric Company's* receiving tube and electronic components replacement business.

In his new position Mr. Burns will plan and direct sales policies and activities for the firm's nation-wide network of sales offices which supply components to wholesale electronics distributors.

For nearly eight years he served as field sales manager for the company's replacement tube operation in Schenectady, New York. He has been regional equipment sales manager in Chicago for the organization's receiving tube department since May, 1957.

* * *

JOINT TECHNICAL ADVISORY COMMITTEE recently celebrated its tenth anniversary. The Committee was formed in 1948 when the Institute of Radio Engineers joined with the Electronic Industries Association (then the Radio Manufacturers Association) to appoint a group of eight prominent radio engineers as a committee of independent individuals to cooperate with Government and industry in solving technical radio problems of national and international public interest.

During the past ten years the group has rendered valuable service to the Federal Communications Commission and other groups. Its work has contributed to the reduction of radio

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interference, to the more efficient utilization of the band of frequencies available for radio communication, and to numerous other subjects involving government regulations or industry self-control.

The present chairman of the association is Dr. William H. Radford, associate director of Lincoln Laboratory of the Massachusetts Institute of Technology.

* * *

BURT MENDELSON has been promoted to the position of assistant director of marketing for the communications and industrial electronics division of *Motorola Inc.*

He had been manager of the market and product planning department of the division, which manufactures two-way radio and other industrial communications equipment.

In his new position Mr. Mendelson will continue to supervise new product and market planning activities as well as assist in management of all marketing department functions.

* * *

COMMANDER E. F. McDONALD, JR., founder-president and more recently board chairman of *Zenith Radio Corporation,* died recently after being hospitalized for several months.

Commander McDonald had been a business leader and prominent citizen in Chicago since 1910 and was internationally known as a yachtsman, explorer, and author. Under his leadership the electronics organization grew from a small operation to its present position in the radio-television industry.

In 1923 *Zenith Radio Corporation* was formed with McDonald as president. That same year he established one of the nation's first broadcast stations, WJAZ at the Edgewater Beach Hotel, and then founded the National Association of Broadcasters of which he became president.

Among Commander McDonald's many "firsts" was the pioneering development of short-wave radio for long distance communications. He outfitted the 1923 Donald B. MacMillan Arctic expedition with transmitters and receivers, thus enabling the expedition to keep in touch with the United States through the long Arctic night, the first Arctic expedition in history to do so.

* * *

HOWARD W. SAMS & CO., INC. is planning a new, ultra-modern plant which will cover 127,500 square feet of a forty-acre park. Situated in a new industrial area at the junction of the main north-south and east-west traffic arteries into Indianapolis, Ind. at 62nd and Guyon Rd., the new facility will be served by a *New York Central Railroad* spur. The plant will be completely air-conditioned and of brick and steel construction . . . **RAYTHEON MANUFACTURING COMPANY** has agreed to purchase 50 acres of land on Route 20 in Sudbury, Mass. The company plans

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to erect an electronics laboratory with approximately 80,000 square feet of space. When completed, the new facility will employ from 300 to 400 employees. It is expected to be used for radar development and will also house an environmental test laboratory . . . **WESTINGHOUSE ELECTRIC CORPORATION** has established a new microwave center in Ithaca, New York. The facility is a branch of the electronic tube division in Elmira, N. Y. . . . Four new product divisions have been established by **HEWLETT-PACKARD COMPANY** in a re-organization and expansion of the company's research and development department. They are: electronic counter, oscilloscope, microwave and signal generator, and audio and video equipment divisions . . . **U. S. ELECTRONICS DEVELOPMENT CORP.** announces the transfer of its entire administrative and manufacturing facility from Glendale, California to Phoenix, Arizona. The new plant, located on a 16½-acre site, has 35,000 square feet of space . . . **U. S. RELAY COMPANY's** new plant at 717 North Coney Avenue, Azusa, Calif. is now nearing completion . . . **LING ELECTRONICS, INC.** has moved into its new offices and manufacturing plant at Culver City, California . . . **MAGNETIC RESEARCH CORPORATION** has formed a new *Magnepulse* division located at 3160 West El Segundo Blvd., Hawthorne, Calif.

* * *

HUGH A. YOUNG has joined *Packard-Bell Electronics Corp.* as sales manager of the technical products division.

Following World War II, in which he served four years as an electronics officer, he joined *Gough Industries, Inc.,* Southern California *Philco* distributors, where he trained salesmen, dealers, and service organizations for the advent of commercial television. He later became sales manager of *Philco Television* and in 1950 rejoined the distributing firm as general manager of its branch operations.

From 1951 until 1954 he supervised western sales activities for the communications equipment division of *Motorola,* first as zone manager and later as regional manager. Since 1954 he has represented several Los Angeles firms, resigning from *Allen B. Du Mont Labs., Inc.* where he was western regional manager, to accept his new position.

Mr. Young is a senior member of the Institute of Radio Engineers, among other affiliations.

* * *

ELECTRONIC INDUSTRIES ASSOCIATION has initiated a new statistical service covering factory sales of printed circuit packages. In announcing the new program it was revealed that during 1957 sales of these components were valued at over $7.3 million.

The new statistical series was initiated at the request of the printed circuit section as part of a program which also contemplates the compilation of accurate industry data on factory sales of printed wiring boards for all types of electronic construction.

* * *

MICHAEL BALOG has been appointed to the newly created post of manager of manufacturing and engineering for the semiconductor division of *Sylvania Electric Products Inc. . . . Burgess Battery Company* announces the election of **FRED J. KIRKMAN** as president . . . The appointment of **PERRY R. ROEHM** as director of marketing for *International Telephone and Telegraph Corp.* has been made known . . . **HARRY SCHECTER** has joined *Zenith Radio Corp.* as merchandising assistant to the firm's vice-president and director of sales . . . *Pilot Radio Corp.* has named **IRA L. JOACHIM** advertising manager . . . **JOHN FABIAN** is the new manager of *Lafayette Radio's* industrial division . . . *RCA* has appointed **CARL V. BRADFORD** director, regional operations . . . *Pyramid Electric Co.* has elected **MILTON N. LaPIDUS** chairman of the board and **RALPH M. SCARANO** president . . . **LEO HAHN** and **EUGENE VAN CLEVE** have been promoted to the positions of field sales manager and advertising sales promotion manager, respectively, of *Emerson Radio & Phonograph Corp. . . . Blonder-Tongue Electronics* named **AMES F. GIORDANO** chief engineer . . . **EDGAR E. STAHL** has joined *Howard W. Sams Co., Inc.* as director of the firm's newly established educational division . . . **W. W. ROODHOUSE** has been "upped" to general sales manager of *Collins Radio Company* . . . **GEORGE W. FELLENDORF** has joined the staff of *Radio City Products Co., Inc.* as sales and contracts manager . . . *C. B. C. Electronics Co., Inc.* has appointed **MANUEL DOXER** to the post of plant manager . . . **JOHN J. KELLY** and **JOHN A. SHEERAN** have been named to newly created managerial posts in the equipment manufacturing division of *Allen B. Du Mont Laboratories, Inc.* Mr. Kelly is the division's director of material and Mr. Sheeran the manager of manufacturing operations . . . **ROBERT L. ANDERSON** is now *Zenith Radio Corporation's* manager of market research and sales statistics . . . *Eitel-McCullough, Inc.* has named **GORDON M. PETERSON** to the new post of administrative assistant to the director of marketing . . . The appointments of **ROBERT L. SHAW** and **HARRY H. MARTIN** as general marketing manager and general manufacturing manager, respectively, have been announced by *Sylvania Home Electronics,* a division of *Sylvania Electric Products Inc. . . .* **RAYMOND P. BERGAN** has been named vice-president, consumer products, of *National Carbon Company,* division of *Union Carbide Corp. . . .* **RAY R. EPPERT** has been named president of *Burroughs Corp. . . . General Cement Mfg. Co.* named **ANTHONY C. VALIULIS** executive vice-president and **RUSSELL D. GAWNE** vice-president in charge of sales . . . **DR. WILLIAM H. DUERIG** has been appointed vice-president in charge

(*Continued on page* 121)

Want REAL high fidelity in a weatherproof speaker?

Only University's 'LC' series offers 3 GENUINE DUAL-RANGE SYSTEMS

with separate bass and treble drivers

BETTER LOWS: Balanced "compression" folded horn, starting with large throat and energized by top quality woofer drivers provides more lows than other designs.

BETTER HIGHS: Driver unit tweeters with exclusive patented wide-angle horn designs transmit more highs with greater uniformity . . . high frequency response that you can hear!

BETTER EFFICIENCY: Dual range theater-type system permits uncompromising design of the woofer and tweeter sections for greatest efficiency. These speakers penetrate noise with remarkable fidelity and intelligibility.

LESS DISTORTION: Separate low and high frequency driver systems with electrical crossover reduce intermodulation and acoustic phase distortion found in other systems which use two different horns on a single diaphragm.

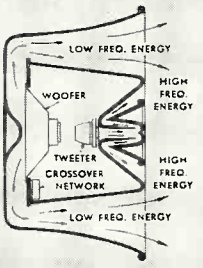
BETTER ACOUSTICS: Smooth projection characteristics, devoid of excessive peaks or "hot spots," help prevent echo and combat reverberation effects . . . every installation is a successful one.

MORE DEPENDABLE: Experienced mechanical engineering and careful electrical design meet the challenge of diversified application and environmental hazards. Rugged and conservatively rated—you can rely on the LC series speakers.

All LC series speakers boast these outstanding features of design, construction and performance. And for maximum economy in amplifier power, equipment and installation costs, each particular model was developed to perform *its* own special function *without compromise.* An added feature is the sturdy serrated "U" bracket for quick easy setups, horizontal or vertical. Choose the specific LC speaker best suited to your next high fidelity installation, indoor or outdoor: sound trucks, auditoriums, stadiums, office buildings, restaurants, church interiors, patios, lawns, etc.

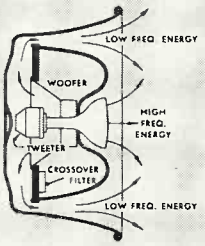
MODEL WLC...Heavy Duty System The largest of the series, the WLC has brought full range high fidelity performance to auditoriums, concert halls, parades and stadiums throughout the world for well over a decade. All the refinements, all the innovations that come of this extensive field experience are embodied in the present production. For exceptional uniformity of response and dispersion of full-bodied sound at higher output levels . . . the WLC is the *only* answer.

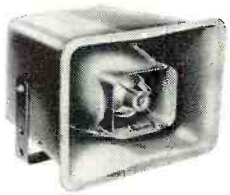
Power capacity: 30 watts. **Frequency response:** 50-15,000 cps. **Impedance:** 8 ohms. **Dispersion:** 90°. **Sound pressure level*:** 120 db. **Diameter:** 33½". **Depth:** 20". **Shpg. wt.:** 72 lbs. **List:** $250.00.



MODEL BLC...For General Applications A sensation the moment it was introduced, the BLC has continued to set new standards for general applications in high quality p.a. work . . . for voice and music, indoor and outdoor. Relatively light in weight, shallow in depth and easy to transport, the BLC can be installed anywhere. It may be used in place of trumpet/driver units (price compares favorably) except under *extremely* noisy conditions or where *maximum* penetration is required.

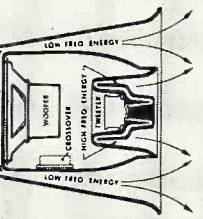
Power capacity: 25 watts. **Frequency response:** 70-15,000 cps. **Impedance:** 8 ohms. **Dispersion:** 120°. **Sound pressure level*:** 119 db. **Diameter:** 22¾". **Depth:** 9¼". **Shpg. wt.:** 21 lbs. **List:** $86.00.





MODEL MLC...Compact Version for Music/Voice Newest in the LC series, the MLC is especially suited for low level speaker distribution systems or for coverage of moderate-size crowds or areas. Unusually good articulation and musical balance make the MLC ideal for paging or sound reinforcement systems where naturalness is important, with no harsh blare or "hot spots." The highly efficient MLC operates easily off existing high fidelity systems for music outdoors at low cost.

Power capacity: 15 watts. **Frequency response:** 150-15,000 cps. **Impedance:** 8 ohms. **Dispersion:** 120°. **Sound pressure level*:** 117 db. **Diameter:** 12¾" w. x 9⅛" h. **Depth:** 10⅝". **Shpg. wt.:** 10 lbs. **List:** $54.50.

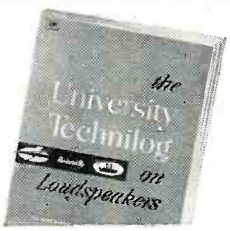


Taken at 4 ft., 750-1250 cps with 1 cps sweep.

Send for the all-new 64-page UNIVERSITY TECHNILOG

Invaluable reference and guide book for planning public address loudspeaker systems. $1.00

Only book of its kind—packed with the solid, factual information you need to save time and money in planning sound systems. Authoritatively covers in detail: how to select the proper driver for the specific job, directional vs. wide-angle horns, best use of radial trumpets, high fidelity in P.A., coping with reverberation, overload protection, etc. Includes comprehensive specifications, charts, diagrams, latest product information and the exclusive SOUND SYSTEM DESIGN CHART — effective guide for planning typical installations. Send $1.00 to Desk S-6, University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y.



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HIGH FIDELITY

Latest Information on the Electronic Industry

Spot News

By RADIO & TV NEWS' WASHINGTON EDITOR

SERVICING INDUSTRY INCOME HAS NEARLY TREBLED SINCE 1951—Electronic equipment installation and servicing income is now over $2.6 billion, EIA Service Committee Chairman Kenneth H. Brown reported recently in his annual report; nearly three times what it was seven years ago.

ELECTRONICS UPSWING NOTED—A very definite upswing, following the slump in the last half of '57, with sales increases ranging from 10% to 40% since January, was revealed by D.C. Duncan, president of the West Coast Electronics Manufacturers Association. He said that '58 volume should approach $14.5 billion, compared with the $13.2 billion recorded for '57. The income figure was based on billing in distribution, service, installation, and broadcasting, as well as general manufacturing.

FCC TO PROBE IMPACT OF CATV, TRANSLATORS, SATELLITES, BOOSTERS ON TELE-CASTING—The impact of community-antenna TV systems and TV translator, satellite, and booster operation on the orderly development of television broadcasting is now being surveyed by the Commission . . . A 14-point quiz is being used to determine whether or not these systems affect broadcasting service . . . CATV systems are reported to be serving half a million homes; they do not now require any FCC authorization. Satellite and translator TV stations are licensed to bring programs to small communities. They do not originate local programs but pick up and re-broadcast programs of outside TV stations, with the latter's permission. Translators operate on the upper 14 u.h.f. channels only and translate (convert) programs of outside u.h.f. or v.h.f. stations for local u.h.f. reception . . . Typical questions posed by the FCC are: How many persons receive their only satisfactory TV service from regular TV stations located in or near communities in which CATV systems, boosters, or translators are operating? What basis, if any, is there for the assumption by the FCC, under present law, of licensing and regulatory powers over CATV systems?

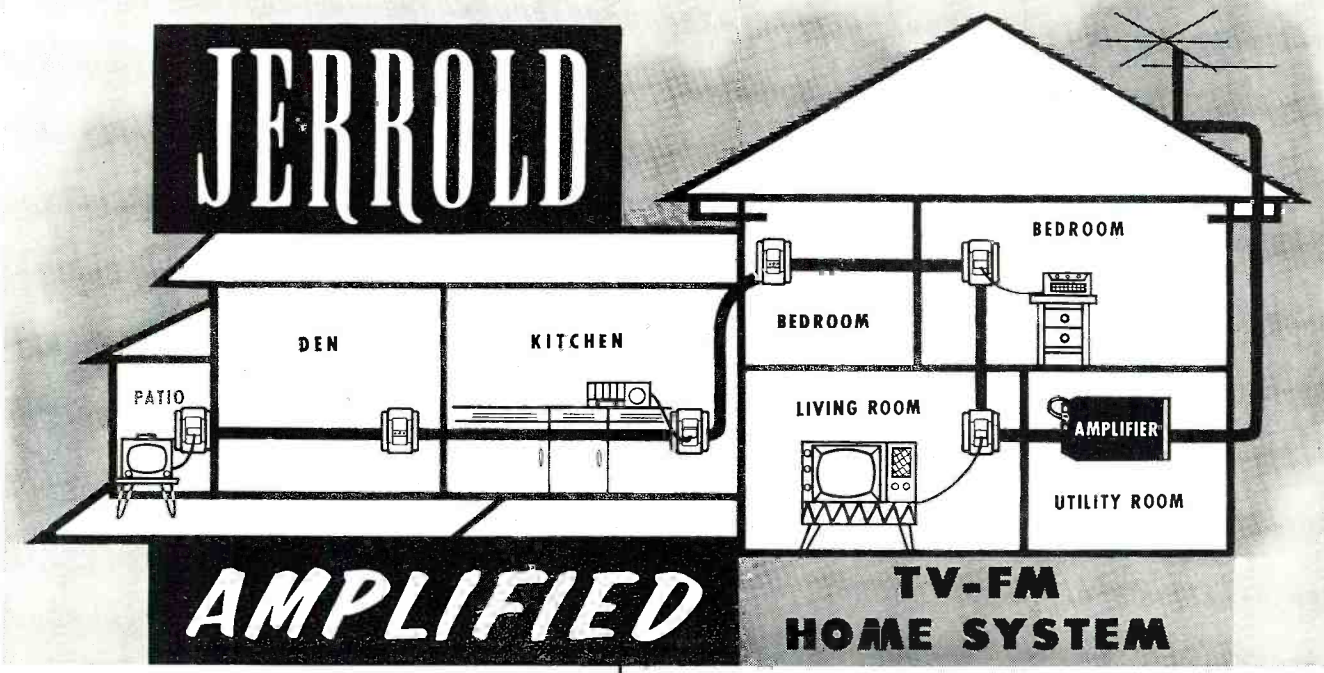
FISHING-BOAT OWNERS PENALIZED FOR FAILURE TO CARRY RADIO—Operators of a 6-passenger 9.8x30.5-foot charter fishing boat, ''Step N Catchem'', found operating off Florida without required radio protection, were fined $600 for the violation . . . and when the money was not forthcoming, a Federal court at Tampa ordered the vessel seized for sale to satisfy the judgment . . . Later, the Government accepted payment of $450 by the craft's owners, on a written agreement to install the required radio equipment.

A.F. CONTROL TOWER OPERATIONS ON WHEELS—A series of seven small two-wheeled trailers containing the necessary equipment for Air Force ground support operations is the latest Air Research and Development Command project to provide fast mobile units for aircraft control and navigational assistance.

NAVY ELECTRONICS RELIABILITY BIBLIOGRAPHY RELEASED—The first two volumes of the Navy Electronics Laboratory's NEL Reliability Bibliography have just been published . . . Reliability research is covered in 10 areas of electronics research and development; circuit design, components, tubes, failure analysis, general human engineering, maintenance, mechanical design, systems, and testing. Basic volume PB 1211838, contains 104 pages and is priced at $2.75. Supplement, PB 121838 S, with 160 pages, is priced at $3.00. Both are available from OTS, U.S. Department of Commerce, Washington 25, D.C.

SIX TRANSLATORS TO SERVE CENTRAL UTAH—Six TV translator stations will soon be translating programs of Salt Lake City stations KUTV (channel 2), KSL-TV (channel 5), and KTVT (channel 4); three (channels 70, 80, and 74) to serve jointly communities of Fillmore, Meadow, and Kanosh, and three (channels 83, 72, and 77) for Delta and Oak City in Millard County, Utah. —30—

It's Here! The Firs AMPLIFIED PLUG-IN TV-FM HOME SYSTEM



* **A Completely Engineered, Fully Amplified System —Not a Multi-Set Booster**
* **Simple...Solderless...300 Ohm Twin-Lead Installation**
* **Sets not "Tied Down", can be moved anywhere**
* **"Snow Free" TV and "Hiss Free" FM Reception**

The FIRST truly engineered, amplified system designed for the home! Supplies *Hi Fidelity* reception to TV and FM receivers in any room! Makes TV sets truly portable . . . new TV and FM receivers can be added with a simple plug-in connection!

The Jerrold Home System features a low noise, high output, printed circuit amplifier that increases the TV and FM antenna signals 6 *times* (15 db). 300 ohm Twin-Lead is used to distribute the amplified signal throughout the home. Receivers are connected to the system by newly designed Home Outlets and Plugs.

The Jerrold Home System opens up a whole new market for the serviceman. It enables him to provide better TV and FM reception in *any signal location.*

For complete details contact your Jerrold distributor or write to Dept. PD 66

HOME SYSTEM COMPONENTS

HOME AMP... MODEL HSA-46

The 1st printed Circuit TV-FM amplifier. Greatly improves weak signals; flat response across entire (VHF) TV-FM band. Only 2 tubes, designed for 24-hr. operation, consumes only 18 watts. Color compatible, UL approved.

$49.95 LIST

◄ FLUSH OUTLET... MODEL HSA-140
$2.75 LIST

SURFACE OUTLET... MODEL HS-135 ►
$1.95 LIST

The outlets supply clear strong signals without interference between sets. Each includes Perma-Grip plug for TV or FM. Color: Ivory.

No Trimming of Wire Necessary...No Soldering! Quick Screwdriver Installation.

ALSO AVAILABLE in ready-to-install kit form

Home System Kit Model HSK-300

Contains everything (except antenna) for complete 5 outlet system—including Twin-Lead.

$67.75 LIST

For Installation in New Homes and Existing Homes.

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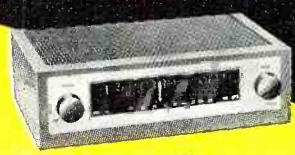
the experts say... in HI-FI the best buys are

EICO®

World-famous EICO advantages guarantee your complete satisfaction:

- Advanced engineering • Finest quality components
- "Beginner-Tested," easy step-by-step instructions
- LIFETIME service & calibration guarantee
- IN STOCK — Compare, then take home any EICO equipment—right "off the shelf"—from 1900 neighborhood EICO dealers. No mail delays, no high penalty freight costs.

Stereo Preamplifier HF85



FM Tuner HFT90

Stereo Amplifier-Preamp HF81

Bookshelf Speaker System HFS1

Monaural Integrated Amplifiers: 50, 30, 20, and 12-Watt (use 2 for Stereo)

Speaker System HFS2 36" H x 15¼" W x 11½" D

Monaural Preamplifiers: HF65, HF61 (stack 2 for Stereo)

Monaural Power Amplifiers: 60, 50, 35, 30, 22 and 14-Watt (use 2 for Stereo)

MEMBER HIGH FIDELITY MANUFACTURERS INC.

Over 1 MILLION EICO instruments in use throughout the world

STEREOPHONIC EQUIPMENT

HF85: Stereo Dual Preamplifier selects, preamplifies & controls any stereo source — tape, discs, broadcasts. Distortion borders on unmeasurable. Self-powered. Works with any 2 high-quality power amplifiers such as EICO HF14, HF22, HF30, HF35, HF50, HF60. Available shortly.

HF81: Stereo Dual Amplifier-Preamplifier selects, amplifies & controls any stereo source — tape, discs, broadcasts — & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Monophonically: 28 watts for your speakers; complete stereo preamp. Ganged level controls, separate focus (balance) control, independent full-range bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers, excellent output transformers. "Low silhouette" construction. Kit **$69.95.** Wired **$109.95,** incl. cover.

MONAURAL PREAMPLIFIERS (stack 2 for Stereo)

HF65: superb new design. Inputs for tape head, microphone, mag-phono cartridge & hi-level sources. IM distortion 0.04% @ 2V out. Attractive "low silhouette" design. **HF65A** Kit **$29.95,** Wired **$44.95. HF65** (with power supply) Kit **$33.95.** Wired **$49.95.**

HF61: "Rivals the most expensive preamps" — Marshall, AUDIOCRAFT. **HF61A** Kit **$24.95,** Wired **$37.95, HF61** (with power supply) Kit **$29.95.** Wired **$44.95.**

MONAURAL POWER AMPLIFIERS (use 2 for STEREO)

HF60: 60-Watt Ultra Linear Power Amplifier with Acro TO-330 Output Transformer; wide band-width, virtually absolute stability & flawless transient response. "One of the best-performing amplifiers extant; an excellent buy.' AUDIOCRAFT Kit Report. Kit **$72.95.** Wired **$99.95.** Matching Cover E-2 $4.50.

HF50: 50-Watt Ultra Linear Power Amplifier with extremely high quality Chicago Standard Output Transformer. Identical in every other respect to HF60, same specifications at 50 watts. Kit **$57.95.** Wired **$87.95.** Matching Cover E-2 $4.50.

HF35: 35-Watt Ultra-Linear Power Amplifier version of the HF60 above. Kit **$47.95.** Wired **$72.95.**

HF30: 30-Watt Power Amplifier employs 4-EL84 high power sensitivity output tubes in push-pull parallel, Williamson circuit, 20 db feedback, & high stability margin. 2-EZ81 full-wave rectifiers for highly reliable power supply. Unmatched value in medium-power amplifiers. Kit **$39.95.** Wired **$62.95.** Matching Cover E-3 $3.95.

HF22: 22-Watt Power Amplifier version of the HF60 above. Kit **$38.95.** Wired **$61.95.**

HF14: 14-Watt Power Amplifier of the HF81 above. Kit **$23.50.** Wired **$41.50.**

MONAURAL INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF52: 50-Watt Integrated Amplifier with complete "front end" facilities & Chicago Standard Output Transformer. Ultra-Linear power amplifier essentially identical to HF50. "Excellent value" — Hirsch-Houck Labs. Kit **$69.95.** Wired **$109.95.** Matching Cover E-1 $4.50.

HF32: 30-Watt Integrated Amplifier combines excellent HF30 power amplifier above with versatile preamplifier featuring tape head & microphone inputs, scratch & rumble filters, all amplifier facilities. Kit **$57.95.** Wired **$89.95.** Both include cover.

HF20: 20-Watt Integrated Amplifier complete with finest preamp-control facilities, excellent output transformer that handles 34W peak power, plus a full Ultra-Linear Williamson power amplifier circuit. "Well-engineered" — Stocklin, RADIO TV NEWS. Kit **$49.95.** Wired **$79.95.** Matching Cover E-1 $4.50.

HF12: 12-Watt Integrated Amplifier provides complete "front end" facilities & excellent performance for any medium-power application. "Packs a wallop" — POPULAR ELECTRONICS. Kit **$34.95.** Wired **$57.95.**

SPEAKER SYSTEMS (use 2 for STEREO)

HFS2: Natural bass 30-200 cps via slot-loaded 12-ft. split conical bass horn. Middles & lower highs: front radiation from 8½" edge-damped cone. Distortionless spike-shaped super-tweeter radiates omni-directionally. Flat 45-20,000 cps, useful 30-40,000 cps. 16 ohms. HWD 36", 15¼", 11½". "Remarkable realism; eminently musical; unusual suitability for stereo." — Holt, HIGH FIDELITY. Completely factory-built: Walnut or Mahogany. **$139.95;** Blonde, **$144.95.**

HFS1: Bookshelf Speaker System, complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. Capacity 25 w. 8 ohms. HWD: 11" x 23" x 9". Wiring time 15 min. Price **$39.95.**

FM TUNER

HFT90: surpasses wired tuners up to 3X its cost. Prewired, pre-aligned, temperature-compensated "front end" — drift-free. Precision "eye-tronic" tuning. Sensitivity, 1.5 uv for 20 db quieting — 6X that of other kit tuners. Response 20-20,000 cps ±1 db. K-follower & multiplex outputs. "Drift absolutely absent; audio quality excellent; novel tuning quite effective." — ELECTRONICS ILLUSTRATED. Kit **$39.95*.** Wired **$65.95*.** Cover $3.95.

*LESS COVER, F.E.T. INCL.

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shows you HOW TO SAVE 50% on 50 models of top quality professional test equipment.

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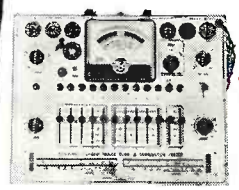

NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication of Gm, Gp & peak emission. Simultaneous sel** of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**

NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased **inereductor** for excellent linearity. **Extremely flat** RF output: **new AGC circuit** automatically adjusts osc. for max. output on each band with min. ampl. variations. **Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in **5 fund. bands. Variable Marker Range** 2-75 mc in **3 fund. bands;** 60-225 mc on harmonic band. **4.5 mc Xtal Marker Osc., xtal supplied.** Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95 WIRED $129.50

• **Features DC Amplifiers!**

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **thruout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **preset TV V & H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

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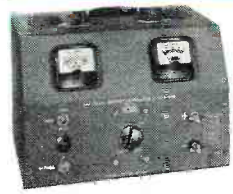

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Scatter Communication

By **MAURICE P. JOHNSON**
U.H.F. Communication Equipment Design Engineer

An ingenious method of transmitting signals far beyond ordinary line-of-sight distances.

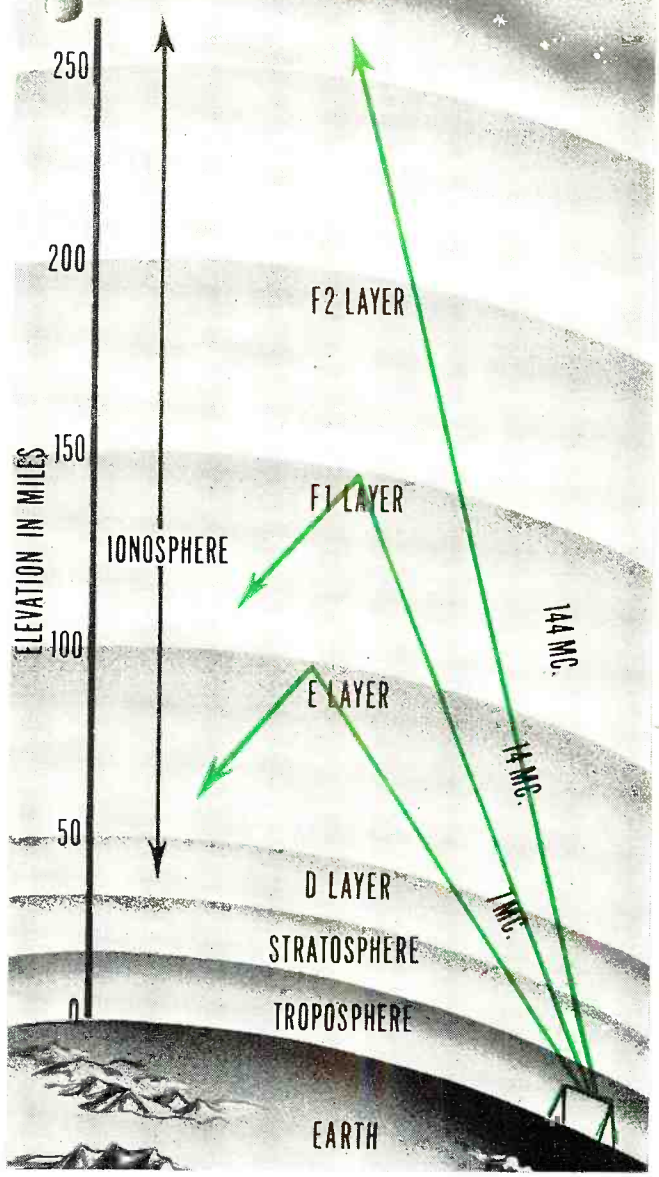
THE advancement of the radio communication art is given impetus by the persistent need for additional channel space as the spectrum fills with various services. In addition, reliability of the communication link is becoming increasingly important. Toward these ends, recent progress has been made in the development and application of a new communication method, known as "trans-horizon" or "scatter" transmission. This article is designed to acquaint the reader with the general principles of this new communication technique.

Ground Waves and Sky Waves

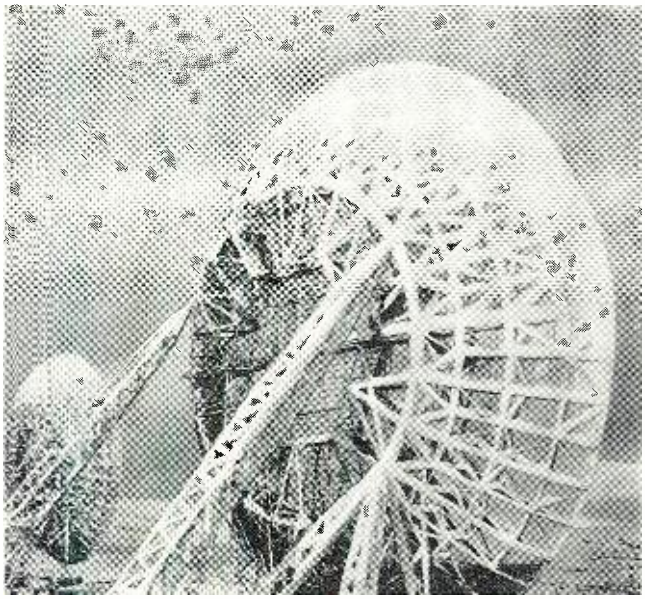
The behavior of the radio waves which are radiated from an antenna is determined, in part, by the operating frequency and by the angle of radiation. Energy leaving the antenna along the surface of the earth is called the ground wave, while that directed upward at an angle is known as sky wave.

The ground wave is of interest because it is utilized by standard broadcast stations in the 540 to 1600 kc. range. This ground wave blankets the local service area of the station, but the signal strength dies out rapidly as the distance from the antenna increases. The energy varies inversely as the square of the distance from the antenna (free-space loss) plus additional attenuation due to absorption by the earth's surface. As the operating frequency is increased, the losses become even greater, so the ground wave is not useful for distant communication except at very low frequencies. Let us then consider the sky-wave component of radiation. This wave would be of little value were it not for the fact that the atmosphere acts to return some of the energy to earth again.

The atmosphere may be considered as a series of layers of gases—primarily oxygen, nitrogen, and hydrogen. The pressure and density decrease rapidly at distances removed from the earth's surface. The "troposphere," the layer closest to the earth, is responsible for weather and cloud formation and, most recently, is being utilized for u.h.f. tropospheric scatter communication to be discussed later. Next is the stratosphere, while at altitudes from 30 to 250 miles exists the layer of importance to sky-wave radio communication, known as the ionosphere.

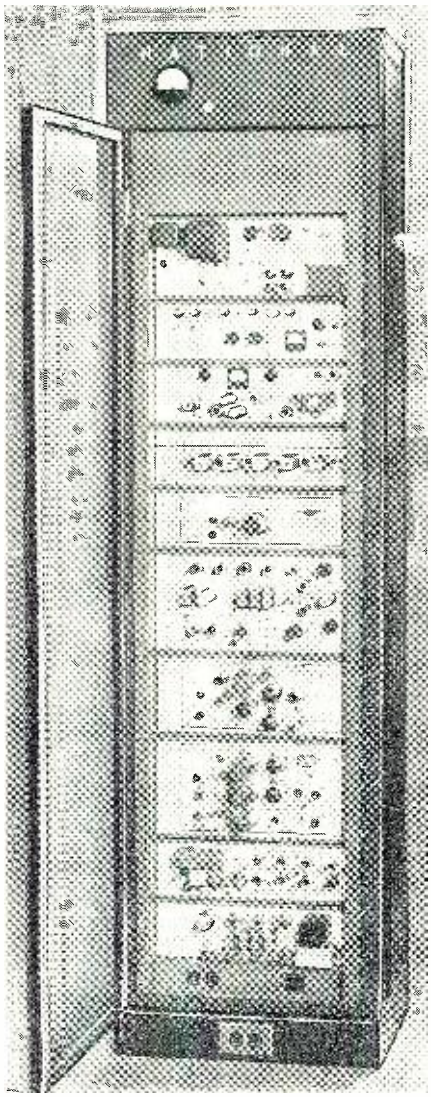


The "Texas Tower" installation at top right makes extensive use of scatter. Drawing at right shows how ionosphere affects radio waves.



An antenna installation in Arctic Scatter Link. This type of communication is being used extensively during the IGY tests.

A rack-mounted receiver used for single-channel scatter circuit. The equipment shown is the Type 1245 made by National Company. This and similar gear is being used in both commercial and military experimental scatter communication work.



Some energy from the sun's ultraviolet radiation is expended in ionizing the atmospheric gases to form the ionosphere. The various gases differ in their ability to absorb this solar energy, so layers of ionization are formed. In order of altitude, these layers are designated as *D*, *E*, and *F*. Since these layers are established from the sun's radiation, it follows that they are subject to variation over the diurnal cycle.

During the day, the *D* layer is found at an altitude of approximately 50 miles. This layer is most intensely ionized at noon and disappears completely at night. It does not reflect the sky wave, but it does absorb energy from, and thus attenuates, signals passing through the layer.

At an altitude of approximately 80 miles is found the *E* layer, also a daytime region, which acts to absorb the lower frequencies, but does reflect waves in the 2 to 10 mc. range back to the earth.

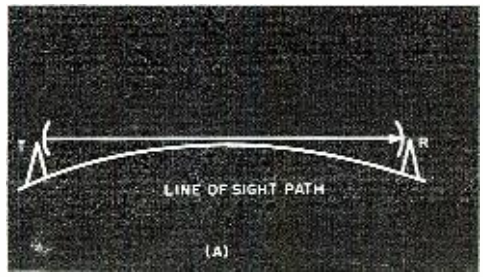
At altitudes of 150 to 250 miles, the interesting *F* layer is found. During daylight hours, this may exist as two separate layers, *F*1 and *F*2, but at night the ionized regions combine to form the single *F* layer. This layer is important because it is the only ionized region which exists at night. Also, because the gas pressure at this elevation is low, there is less variation in the layer from day to night.

Up to about 30 mc., signals passing through the *E* layer are reflected by the *F* layer. Bending by the ionosphere is greatest at lower frequencies; as the frequency increases a point is reached where the bending is insufficient to return the signal to earth and the signal is thus lost to any earthbound receiving site. The distance from the antenna to the point where a signal returns to earth is the "skip" distance and is a frequency function. The transition between useful skip and lost signal is the "critical" frequency. This varies diurnally, seasonally, and with sunspot cycles, but generally occurs near 30 mc. Ionospheric skip has thus made possible long-range communication in the 2 to 30 mc. range, so widely used by short-wave broadcast, ham, and communication services. Higher frequency bands have been used for line-of-sight paths, but this picture is now changing with the development of scatter.

Critical and Usable Frequencies

As the ionosphere is constantly changing, skip propagation is not as dependable or predictable as ground-wave coverage. Just as changes in the troposphere are studied and predicted by the meteorologist, the ionospheric phenomena have been subjected to study and forecast. Some terms used in this study are worthy of mention. The "critical frequency" is the highest frequency which will be returned to earth when a wave is directed vertically upward toward the sky. This is not necessarily the same as the highest frequency which can be reflected back to earth if the wave is directed at an angle toward the ionosphere. The

Fig. 1A. Simplified drawing illustrating the "line-of-sight" path principle.

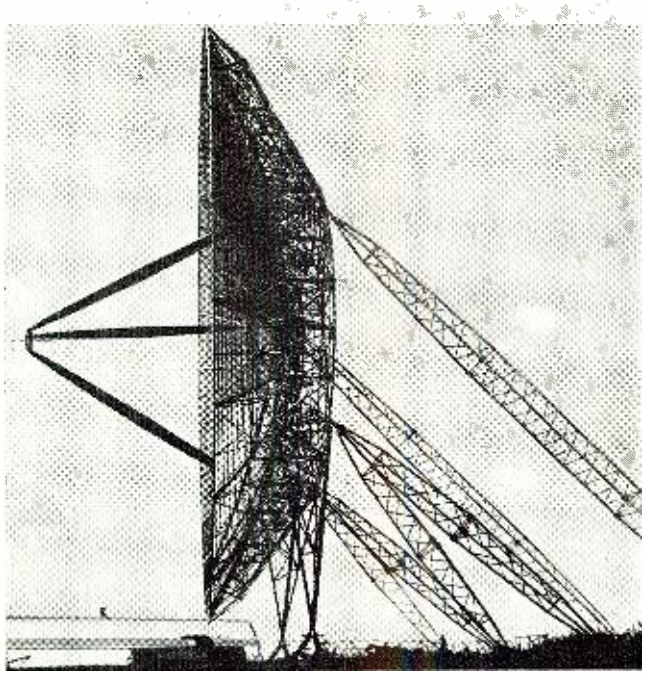


"maximum usable frequency" (m.u.f.) is the highest frequency which will be reflected back to a specific receiving location. The m.u.f. may then be higher than the critical frequency because of the angle involved. The "optimum working frequency" (o.w.f.) takes into account the possibility of the m.u.f. changing during an operating period, by providing a safety factor to keep ionospheric changes, weather, sunspots etc. from destroying the communication system. Therefore, the o.w.f. is lower than the m.u.f. and is changed according to ionospheric conditions. Thus, it becomes necessary to keep changing the o.w.f. in order to maintain a reliable link over a given distance.

Determining the o.w.f. would not be difficult if the ionosphere were not constantly changing. The "normal" changes which may be expected, such as the change in virtual height of the layers with time of day and season, may be predicted from year to year with some accuracy. The critical frequency is also highest in years with large sunspot numbers, in accordance with the eleven-year sunspot cycle. However, additional "abnormal" variations may occur, such as meteor showers, sporadic-*E* ionization, sudden

ionospheric disturbances (s.i.d.), solar flares, and polar blackouts due to aurora and cosmic rays, all of which reduce the reliability of ionospheric skip communication. While some ionospheric changes may be forecast, the many unpredictable events which may completely block or destroy the signal make skip communication networks far from dependable.

It might be thought that high-power ground wave would be more reliable, but it is not the complete answer. This wave is so severely attenuated at the higher frequencies as to be of no use. In the broadcast band, another difficulty presents itself. At night the *D* layer disappears and with it the absorption so that now some sky wave is returned to earth. At a receiving point, the phase difference between sky and ground wave causes fading. Due to the frequency differences among carrier, upper, and lower sidebands, there is frequency selective fading with resultant audio distortion. This interference at the outer limits of the ground wave may actually reduce the service area.

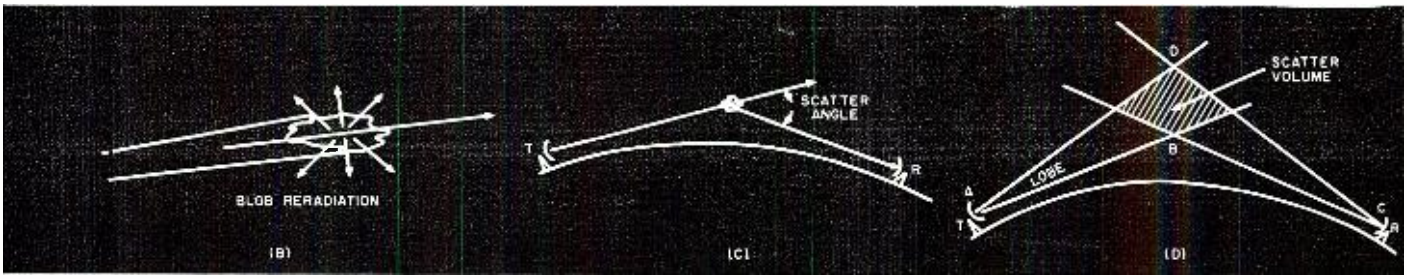


Scatter propagation dish-type antenna. The car parked near lower rim of antenna gives some indication of its tremendous size.

Fig. 1B. Signal re-radiation from "blob" is shown here and discussed in the text.

Fig. 1C. The scatter angle developed when signal is re-radiated from the "blob."

Fig. 1D. The geometry of a signal path. It will be noted ABC is shorter than line ADC.



"Churns" and "Blobs"

In general, this was the status of the long range communication art prior to World War II. Tremendous development and progress in electronics came about because of the war. In particular, radar work resulted in better tubes, high-gain antennas, higher power high-frequency transmitters, and sensitive receivers with low noise factors. These improvements opened higher frequency bands for radar, microwave links, and television broadcast services. Microwave provided more reliable communication systems than heretofore but was limited to line-of-sight distance per "hop." However, as system performance was improved, some new aspects of propagation were discovered and verified. Previous smooth-earth theory held that signals should attenuate very rapidly beyond the horizon, for the usual line-of-sight-link. However, during and after World War II, it was found that radar ranges were greater than expected in the v.h.f. and u.h.f. bands. At first, this beyond-the-horizon signal was considered an unwanted additional interference. In 1949, the "freeze" on new TV station construction was put into effect because co-channel TV interference proved greater than anticipated. Studies made by 1950 revealed that signals from 40 to 4000 mc. were stronger than indicated by current propagation theory. Inversions, ducts, elevated layers, and other theory could explain high signal levels, but investigations showed that the signals were strong even when such phenomena did not exist.

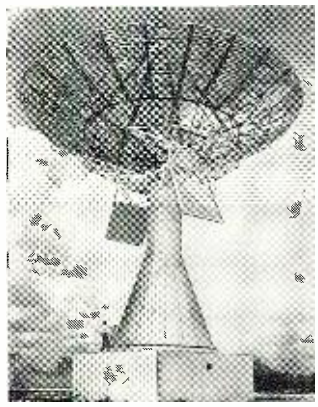
The error was attributed to the assumption that the atmosphere was homogeneous or that it varied in a smooth, gradual manner. It is now thought that the atmosphere is in a constant state of turbulence and, as the medium "churns," eddies are formed. This theory of turbulent areas, or "blobs," was advanced by 1950 and serves to explain the medium of scatter. See Figs. 1A, B, C.

Frequencies above about 30 mc. are generally considered to be beyond the m.u.f., that is to say, they are not normally returned to earth in the conventional ionospheric skip manner. To test the principles of scatter, experimental transmissions were made with high power, over paths of several hundred miles between transmitter and receiver, at frequencies in the 50 mc. range. Although this was above the m.u.f., a consistent but weak signal

An Eimac 3KM50,000PA klystron mounted in a complete scatter amplifier. The magnetic framework, external resonant cavities, and magnetic beam control coils are visible in this close-up view photograph. High output powers can be generated.

COVER STORY

GIANT TELEMETRY ANTENNA



THE giant telemetry antenna shown on this month's cover and in the photo above is the first of five such units being scheduled for use in tracking ICBM's.

Constructed by Radiation, Inc., of Melbourne, Florida, the spider-web-like antenna has been designated as the TLM-18 automatic tracking telemetry antenna. It is currently undergoing tests at Melbourne (approximately 16 miles from Patrick AFB) prior to its use by the Air Force.

Standing higher than a seven-story building, this huge piece of missile-tracking equipment is 60 feet in diameter and is mounted on a steel tower 38 feet high and 20 feet wide. The tower houses the cables and driving mechanism which operate the antenna at its required speeds. Data-recording mechanisms and remote controls are located in separate, nearby buildings.

The new antenna is designed to withstand hurricane-velocity winds of up to 125 miles an hour.

Depending on a highly complex electronic operation, the telemetry antenna system consists of a small radio transmitter aboard the in-flight missile. This transmitter is equipped with a pickup device which samples such phenomena as pressure, temperature, acceleration, and control movement. Converted into electronic signals, the collected data is then transmitted continuously from the missile to ground.

Besides tracking intercontinental missiles, the TLM-18 is capable of tracking the sun and other so-called "radio stars." This factor will make the antenna a valuable asset in earth satellite experimentation during the current International Geophysical Year.

The Melbourne unit is a predecessor to the four proposed missile-tracking devices to be erected at selected sites. These new units will be built by the same company upon completion of tests to determine the antenna's operational capabilities.

First of the proposed construction locations will be the Air Force Missile Test Center's Cape Canaveral, Florida, launching site. Approximately 18 miles north of Patrick AFB, the Cape Canaveral missile site consists of 14,513 acres of government-owned land. It was transferred from Navy to Air Force jurisdiction on September 1, 1948.

A part of the Air Research and Development Command, the Air Force Missile Test Center (AFMTC) operates the Florida Missile Test Range—the world's longest range for testing guided missiles.

The Center's mission includes conducting tests and evaluating as well as collecting test data on guided missiles, controlled targets, drones, and related equipment for the Air Force and, on occasion, for the Army and Navy.

Besides operation of telemetry stations that are much smaller than the Melbourne unit and which are located at numerous islands sprinkled throughout the Atlantic, ARDC also has at its disposal a chain of floating bases that currently bridge about 3000 miles of ocean. Timed to coincide as closely as possible with missile tests, a fleet of re-commissioned World War II and Korean freighters are being used by ARDC to pick up and transmit data to the Cape Canaveral Center.

Three other proposed sites for construction of the giant telemetry antennas include the Missile Test Center facilities on Antigua, B.W.I.; Fernando de Noronha Island, off the east coast of Brazil; and Ascension Island in the south Atlantic. The four antennas will cover the entire 5000 mile distance of the range with a moderate overlap. The new telemetry antennas thus will supersede existing tri-helix antennas at the Cape and several of the auxiliary island stations. The older antennas, which provide manual tracking, will be retained for back-up use. (Cover photo U. S. Air Force)

was received. This beyond-the-horizon link was possible because of scatter, which we shall now discuss.

Over line-of-sight paths, the transmitting and receiving antennas are aimed at one another so that propagation takes place directly without using atmospheric reflection. However, if the transmitting antenna is tilted up toward a "blob" in the atmosphere, most of the energy will continue on through the blob and be lost to a receiver on the earth's surface. But, according to a theory in physics (Huygen's wavelet principle), this blob may be considered as receiving and re-radiating the signal. If we recall the action of the parasitic elements of a yagi TV or ham antenna, the re-radiation idea may be made clear. While most of the incoming energy will be re-radiated forward, some small amounts of energy are re-radiated in other directions in varying strengths. If the receiving antenna is directed at this blob, it will not be possible to receive the energy that continues in the forward direction, but it will collect some of the off-beam scattered signal which is of reduced strength. Over the path, the scatter signal is thus greatly attenuated, but of great importance is the fact that a signal may now be received at a point well beyond the horizon.

The transmitting antenna has a radiation pattern or lobe in the form of a beam or cone-shaped volume. High-gain antenna systems may have a lobe narrowed to 5 degrees or less in order to concentrate the power in the desired direction. In the region of the atmospheric blob, however, the lobe has considerable cross-sectional area, so that a number of blobs may be excited within the cone area. The receiving antenna, aimed at this same region, "sees" a volume rather than a point in the atmosphere. This volume is the "scatter volume."

Scatter Paths

Let us examine the path geometry diagrammed in Fig. 1D. It will be noticed that the distance *ABC* is shorter than the distance *ADC*. The path length from transmitter-to-blob-to-receiver will be different for each blob in the scatter volume. The lowest usable edge of the lobes will be tangent to the earth, which is the shortest path distance, and thus provides the strongest signal. Higher angle, longer path length result in reduced signal strength because of increased free space loss plus reduced density in the upper scatter volume.

The total received signal is the sum of the re-radiated energy which can be collected from all blobs in the scatter volume. Differences in path distances within the lobe cause delay differences in the multiple received signals. Less delay will be experienced in narrow beams, but the attendant reduction in the effective scatter volume results in consequent loss in total received signal.

In the broadcast band, differences in path lengths cause fading. In scatter, the similar effect is known as multi-path fading or multi-path distortion. This results in time and frequency distortion in the combined received signal. Time distortion will lengthen or smear a transmitted pulse, while frequency distortion results in frequency selective fading. The situation is further complicated by the constant agitation inherent in the blobs within the scatter volume, which adds to the multi-path fade problem. Thus, a normal characteristic of a scatter signal is a rapid continual deep fade.

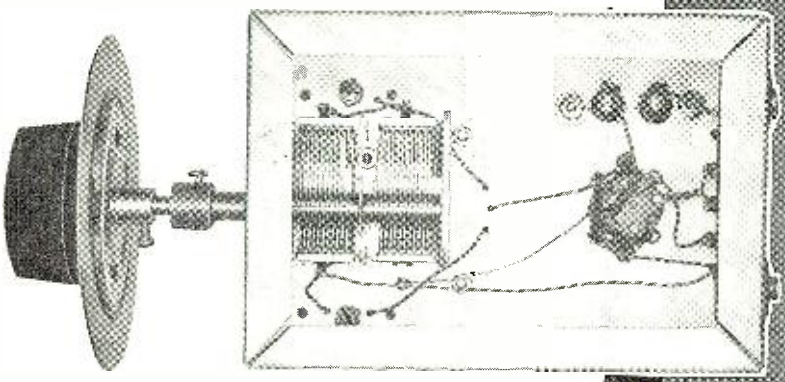
The path loss is great for a scatter signal and may be on the order of 100-150 db for an average distance. The loss is high because only a small part of the re-radiated energy from the blobs is in such a direction that it can be collected by the receiving antenna. Other losses may be encountered if antenna lobes do not cover the optimum scatter volume for the distance involved. This is "antenna-to-medium coupling loss." Also, an antenna made for high gain may be so large in terms of wavelength that there will be phase changes over the aperture, resulting in some additional loss.

Thus it is found that for a given distance between transmitter and receiver, there will be optimum values for beamwidth, scatter volume, and the scatter angle. Despite multi-path distortion, severe rapid fades, and weak signal because of high path

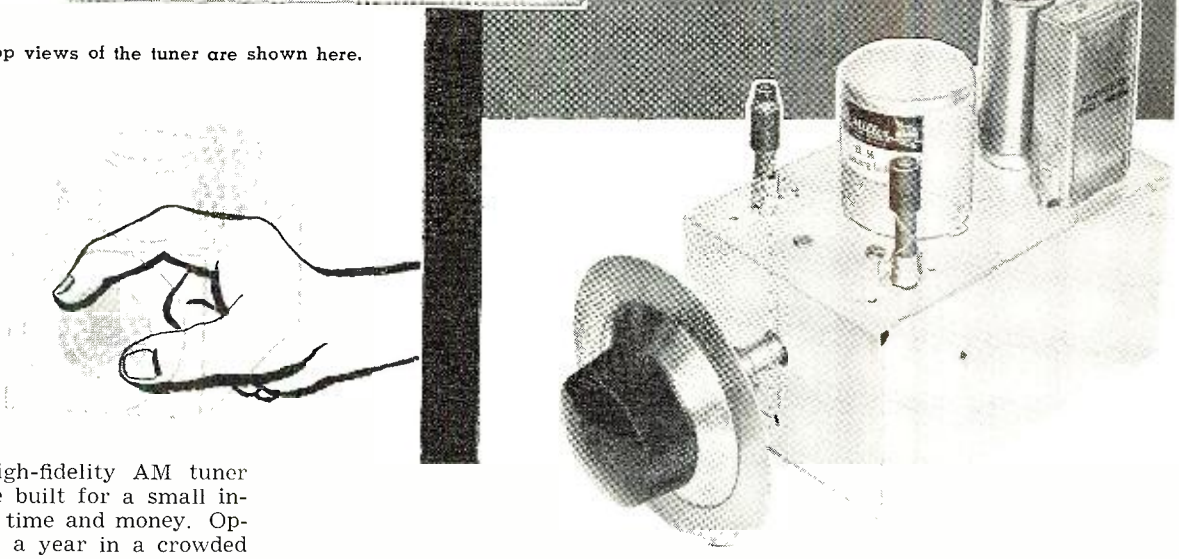
(*Continued on page* 112)

By **JOHN D. MORRIS**

Simple Hi-Fi AM Tuner



Bottom and top views of the tuner are shown here.



One-tube unit features broadband circuits with infinite-impedance detector for good performance.

HERE is a high-fidelity AM tuner that may be built for a small investment in time and money. Operating for over a year in a crowded broadcast-band area, the tuner has performed well enough to merit the construction of several additional units for interested audiophiles. These duplicates, operating in locations from 5 to 20 miles from transmission sources, have in each case performed as well as the original. All local stations are received without adjacent-channel interference, attesting to the tuner's sensitivity and selectivity. Parts for the unit are readily available from large wholesale parts jobbers at a cost of less than ten dollars.

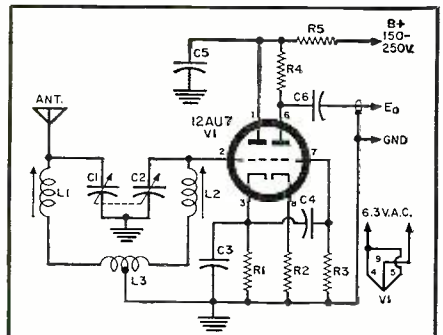
Circuitwise, the tuner is quite simple, employing a negative mutual-coupled *LC* circuit with high-"*Q*" "Vari-Loopsticks," an infinite-impedance detector, and a voltage amplifier.

The infinite-impedance detector's high input impedance reduces the loading on the tuned circuit, thereby permitting full utilization of the tuned circuit's high "*Q*," with resultant good sensitivity and selectivity. The low distortion output inherent in this type detector provides the cleanest audio available for AM listening. Voltage amplification is added to raise the signal to a more acceptable level for further amplification.

The original tuner, shown in the photographs, was housed on a 4" x 5" x 6" aluminum box chassis. The duplicates, however, used the open-sided "Mini-box" chassis, making the wiring job much easier. The *Vector* socket and oil-filled capacitor shown in the photos are not absolutely necessary and were obtained from "on hand" parts.

The power source for each unit was its associated main power amplifier.

Schematic diagram of unit described above.



R_1, R_3—100,000 ohm, ½ w. res.
R_2—1200 ohm, ½ w. res.
R_4—470,000 ohm, ½ w. res.
R_5—10,000 ohm, ½ w. res.
C_1, C_2—365 μμfd. ganged var. capacitor
C_3—250 μμfd., 200 v. ceramic capacitor
C_4—.05 μfd., 200 v. capacitor
C_5—25 μfd., 400 v. elec. capacitor
C_6—.1 μfd., 400 v. capacitor
L_1, L_2—"Vari-Loopstick" (see text)
L_3—Shielded negative mutual coupling coil (Miller EL-56)
V_1—12AU7 tube (see text)

With such low power requirements, 150-250 volts @ 10 ma. and 6.3 volts @ .3 amp., a small inexpensive and independent power supply may be added if desired.

An antenna is necessary. Twenty-five to fifty feet is adequate, depending upon location. All units built to date operate successfully on attic antennas approximately thirty feet long.

For those persons in more remote areas, a 12AX7 may be substituted for V_1 to increase the gain.

To align, set C_1-C_2 to its mid position and adjust L_2 until a known station at or near the center of the broadcast band is heard. Then adjust L_1 for maximum volume. Next, check for stations appearing at each end of the band and re-adjust L_2 if necessary. Normally L_1 is adjusted for maximum signal strength at the center of the band but station frequencies in different areas may dictate shifting this signal strength adjustment (L_1) to one side of the band or the other.

You will experience moderate blasting when tuning due to lack of a.v.c. action. This effect, however, is more than compensated for by the excellent fidelity and over-all performance of the tuner. —30—

By **ED BUKSTEIN**
Northwestern Television & Electronics Institute

Basic Decade Counters

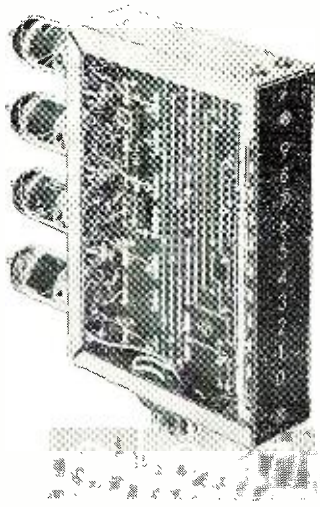


Fig. 1. A Hewlett-Packard plug-in decade counter using four flip-flop twin triodes, visible at the left.

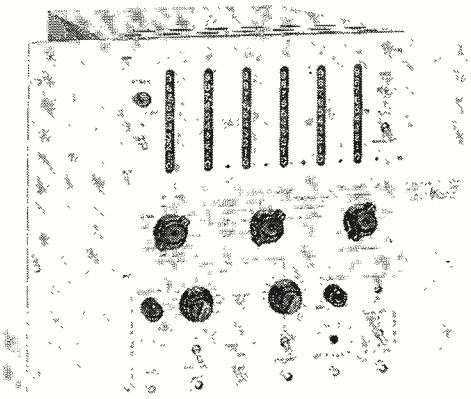


Fig. 2. This Hewlett-Packard counter uses 6 decades in cascade to count to 999,999. Auxiliary frequency standard and gate circuits are included.

How to count by tens electronically using binary circuits. Some interesting, specific applications.

IN A FLIP-FLOP circuit—the bistable multivibrator used in counting circuits—one of the tubes is in conduction while the other is cut off. Because these conditions reverse each time a pulse is applied to the first two stages, two input pulses are required to restore the two-tube circuit to its starting condition. As a result, the output frequency of a flip-flop stage is only half as great as the input frequency. Additional flip-flop stages connected in cascade after the first will increase the scaling ratio to 4, 8, 16, 32, 64, 128, or higher, depending on the number of added stages. (For a fuller treatment of the circuits used and the counting techniques involved, see "Basic Electronic Counting," page 122, March, and "Basic Binary Counting Circuits," on page 48 of our May, 1958 issue.)

However, many applications require a circuit having a scaling factor of 10, which corresponds to our system of decimal counting. While basic, binary-counting, cascaded flip-flops cannot provide such a factor, it is possible to derive such a circuit from a 4-stage flip-flop by adding appropriate feedback networks to make the complete circuit produce one output pulse for every 10 input pulses. Such a circuit, altered to divide by ten, is known as a decade counter.

A four-stage flip-flop circuit would normally (without feedback) have a scaling ratio of 16 and the conditions of the individual stages would switch progressively to the *zero* and *one* states as shown in Table 1, as pulses are successively applied. (When each stage is in the *zero* state, the left-hand tube is cut off and the right-hand tube is conducting. The opposite condition is known as the *one* state.) The circuit starts with all four stages in the *zero* condition. After 16 input pulses, all stages are back to the *zero* condition and an output pulse from the entire circuit is produced by reversal of the fourth stage. To convert this four-stage circuit to a decade counter, feedback circuits are used to make the circuit skip over six of the conditions listed in Table 1. These feedback circuits are shown by the broken lines in Fig. 3.

When the 4th stage of Fig. 3 goes to *zero* condition, its left-hand tube is cut off. The resulting high plate voltage present at this tube is coupled through the feedback networks to the left-hand grids of the second and third stages. As a result, these stages switch to the *one* condition. At this time, the conditions of the four stages are 0110. As input pulses are applied to the circuit, the stages will now switch as indicated in Table 2. When the tenth input pulse is applied, the fourth stage switches to the *zero* state and provides a negative pulse at the output terminal. At the same time, the left-hand plate of the fourth stage feeds a positive pulse through the feedback circuits to the second and third stages. The circuit is now back to the 0110 (starting) condition and further input pulses will cause it to repeat the switching sequence listed in Table 2. It is of interest to note that a four-stage flip-flop circuit *without* feedback would reach the 0110 condition after six input pulses (see Table 1). The circuit of Fig. 3 is set to the 0110 condition as a result of feedback and therefore skips over the first six of the sixteen possible conditions that are listed below in Table 1.

There are other possible feedback arrangements which will convert a four-stage flip-flop into a decade counter. Another commonly used circuit is shown in the block diagram of Fig. 4. The switching actions which occur in

Table 1. Sequence of conditions for a 4-stage binary that counts to 16.

PULSE	CONDITIONS OF FLIP-FLOPS 4th stage	3rd stage	2nd stage	1st stage
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1
16	0	0	0	0

Table 2. The sequence of conditions for the decade counter shown in Fig. 3.

PULSE	CONDITIONS OF FLIP-FLOPS 4th stage	3rd stage	2nd stage	1st stage
0	0	1	1	0
1	0	1	1	1
2	1	0	0	0
3	1	0	0	1
4	1	0	1	0
5	1	0	1	1
6	1	1	0	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1
10	0	1	1	0

Table 3. The sequence of conditions for the decade counter shown in Fig. 4.

PULSE	CONDITIONS OF FLIP-FLOPS 4th stage	3rd stage	2nd stage	1st stage
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	1	0
5	0	1	1	1
6	1	1	0	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1
10	0	0	0	0

this circuit are, with two exceptions, the same as would occur without feedback in the sequence of Table 1. The two exceptions are listed below.

1. On the fourth input pulse, the third stage switches to the *one* condition and feeds a pulse back to the second stage. This leaves the circuit in the 0110 condition. (See Table 3.) Since, without feedback, this condition would not have been reached until the sixth input pulse (compare with Table 1), the circuit has in effect jumped ahead by an amount equal to two input pulses.

2. On the sixth input pulse, the fourth stage switches to the *one* condition and feeds a pulse back to the third stage. This leaves the circuit in the 1100 condition (third and fourth stages in the *one* state). Since, without feedback, the circuit would not have reached this condition until the 12th input pulse (again, compare Tables 1 and 3), the circuit is now "ahead" by an amount equal to six input pulses.

The feedback networks of Fig. 4 supply the equivalent of six input pulses. For this reason, only ten actual input pulses need be applied to restore the entire circuit to its starting condition: 0000. At this time, a pulse appears at the output terminal due to reversal of the fourth stage.

Decimal read-out lamps may be connected to a decade counter to indicate, in decimal notation, the number of pulses stored in the circuit. This is possible because the conditions of the four flip-flops are unique for any given number of input pulses. For example, Table 3 shows that the 0011 condition will exist *only* after the third input pulse, the 1110 condition will exist *only* after the eighth pulse, etc. Ten neon lamps may therefore be connected to the decade in such a way that each lamp will light up only for a specific set of *zero* and *one* conditions.

Fig. 6A illustrates the connections required for the decade of Fig. 4. One terminal of each lamp is connected either to the right-hand or left-hand plate in the first flip-flop stage. The other terminal of each lamp is connected to plates of two other stages. The lamp will glow only when its terminals are connected to points whose voltages differ by an amount sufficient to ionize the neon. This will occur when the plate of the first stage is at a high potential (tube cut off) and the other two plates to which the lamp is connected are both at a low potential (tubes conducting).

These conditions are illustrated in Fig. 6B for lamp No. 8. After the eighth input pulse has been applied, the four stages are in the 1110 condition listed in Table 3. The No. 8 read-out lamp is connected to the left-hand plate of the first stage. This plate is at a high potential because the tube is cut off. The other terminal of lamp No. 8 is connected to the left-hand plates of the second and fourth stages. These plates are at a low potential because the tubes are conducting. The difference in potential across the neon lamp is therefore sufficient to produce a glow.

A decade counter of the type illustrated in Fig. 4 is shown in Fig. 1. The four twin triodes are visible at the left and the entire decade is mounted on an octal socket, partly visible at the bottom, for plug-in use. The read-out lamps are mounted behind the numerals at the right, so that the numerals are illuminated in succession as input pulses are applied to the decade.

Decade counters of this type are

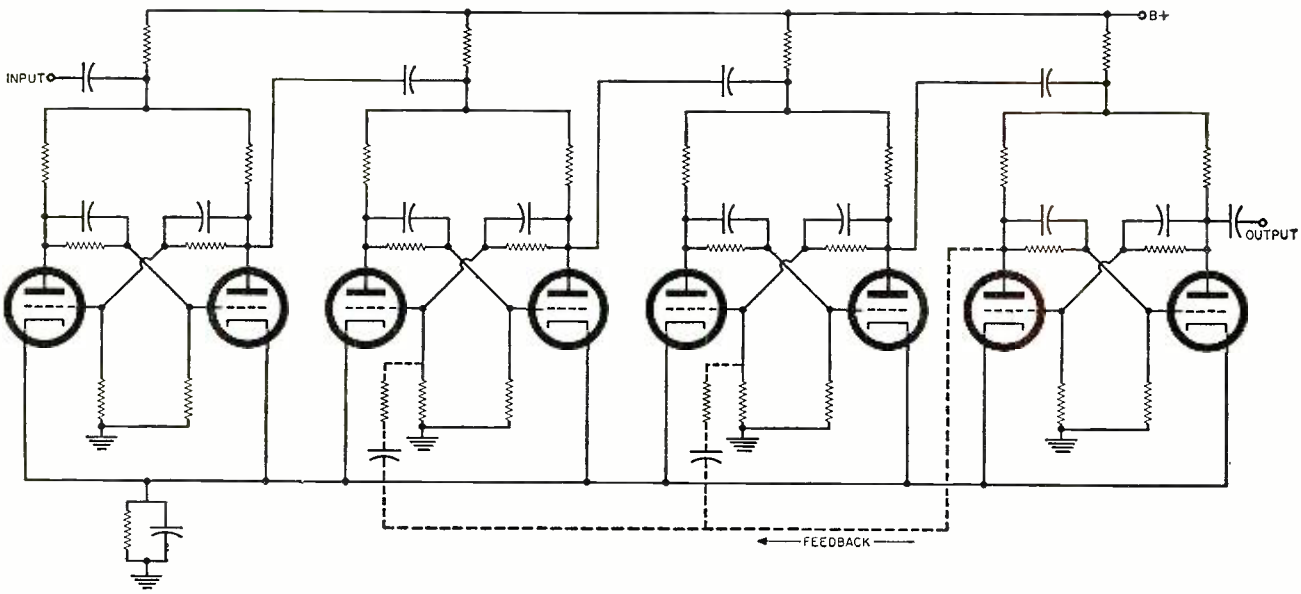


Fig. 3. With feedback added as shown, four cascaded binaries will count to 10.

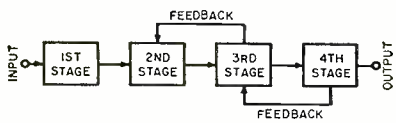
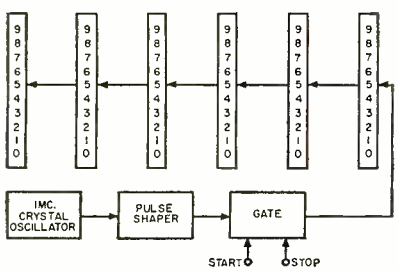
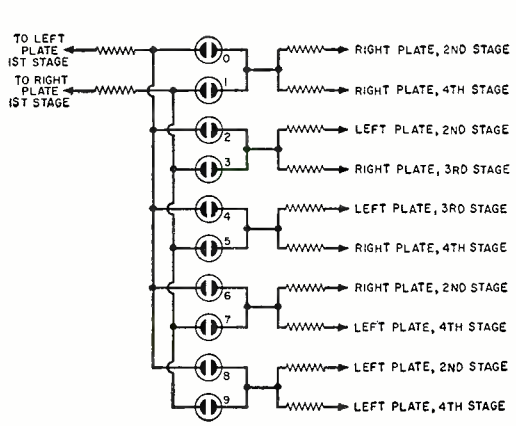


Fig. 4. An alternate feedback method.

Fig. 5. Circuit for time measurements.





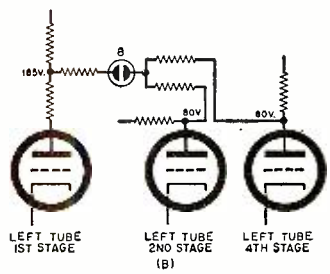


Fig. 6. Hook-ups for read-out lamps in a decade like that of Fig. 4.

often connected in cascade to increase counting capacity. After ten input pulses to the first decade, its output pulse feeds into the second decade. After the second decade has received ten input pulses, it feeds a pulse to the third decade, etc. The electronic counter shown in Fig. 2 uses six decades in cascade, and therefore has a counting capacity of 999,999. The 1,000,000th input pulse to the instrument will restore all stages of all decades to the *zero* state and cause all of the zero read-out lamps to light.

Measuring Time Intervals

Fig. 5 illustrates the use of cascaded decade counters for the purpose of time-interval measurements, one of the many applications to which they have been adapted. The output of the crystal-controlled oscillator is shaped into a pulsed waveform and then applied to a gate circuit. Pulses which pass through the gate are counted by the decades. The design of the gate circuit is such that no pulses can pass through until a *start* pulse is applied. This opens the gate and allows pulses to get through until the gate is closed again by a *stop* pulse. The decade lights therefore indicate the number of pulses which pass through the gate during the interval between the application of the start pulse and the stop pulse. When a 1-megacycle oscillator is used, as in Fig. 5, pulses are applied to the gate circuit at a rate of a million per second. The decade lights therefore indicate, in microseconds, the length of time the gate remains open.

For time-interval and velocity measurements, phototubes are often used to produce the start and stop pulses. The light beams which illuminate these phototubes are arranged to cut the path of the object whose velocity is to be measured. When the object crosses the first light beam, the phototube produces a start pulse to open the gate. The gate is closed again by the stop pulse produced when the object interrupts the second light beam. Since the distance between the light beams is known in advance and since the time required for the object to travel this distance is indicated by the decade lights, the velocity of the object can be determined easily.

The circuit diagram of a gate circuit is shown in Fig. 7. Both input grids of tube V_3 are biased below cut-off. The tube cannot conduct until *both* input grids are brought above cut-off simultaneously. The positive pulses applied to input #1 overcome the bias on this grid, but the tube still remains cut off because of the bias on input grid #2. When a start pulse is applied to the flip-flop stage, the latter switches from the *zero* to the starting or *one* condition. In the latter condition, tube V_2 cuts off and its plate voltage rises. The increase in voltage is coupled to the #2 input grid of tube V_3. Because this grid is now above cut-off, the positive pulses applied to input #1 will be amplified. V_3 continues to produce output pulses until a stop pulse is applied to the flip-flop. At this time, the flip-flop switches back to the *zero* condition and the plate voltage of V_2 decreases. Because input grid #2 is now below cut-off again, tube V_2 can no longer amplify the pulses to input #1.

Frequency Measurement

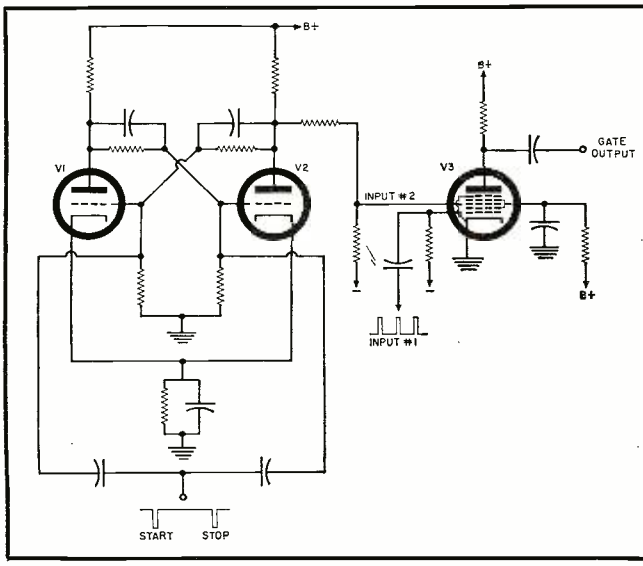
With slight modifications, the circuit arrangement shown in Fig. 5 can be used for extremely accurate measurement of frequency. In this application, the unknown frequency is used in place of the crystal-controlled oscillator. Start and stop pulses are now applied to the gate circuit exactly one second apart. Since the gate remains open for exactly one second, the number of pulses which pass through the gate is the unknown frequency in cycles-per-second. This frequency can now be read directly from the decade lights! The number of decades used determines the number of digits to which the frequency can be measured. The accuracy of this method depends upon the accuracy of the one-second spacing of the start and stop pulses. The block diagram of Fig. 8 shows how the time-spacing of the start and stop pulses may be brought under accurate control.

The output of the 1-megacycle oscillator in Fig. 8 is fed through a pulse shaper and then applied to the six decades in cascade at the bottom of the diagram. Since the output frequency of each decade is a tenth of its input frequency, the first decade produces pulses of ten-microsecond spacing, the second decade produces pulses of 100-microsecond spacing, and so on up to 1-second spacing. The time-base switch therefore permits control of the length of time the gate circuit remains open.

With the switch in the position shown in Fig. 8, the gate will remain open for one second. Negative pulses at the rate of one per second are fed through the time-base switch to the left-hand tubes of both flip-flop stages *A* and *B*. These flip-flops therefore remain in the *zero* condition (left tube cut off and right tube conducting). Action in the circuit is initiated by feeding a *read* pulse to the right-hand tube of flip-flop *B*, which now switches to the *one* condition.

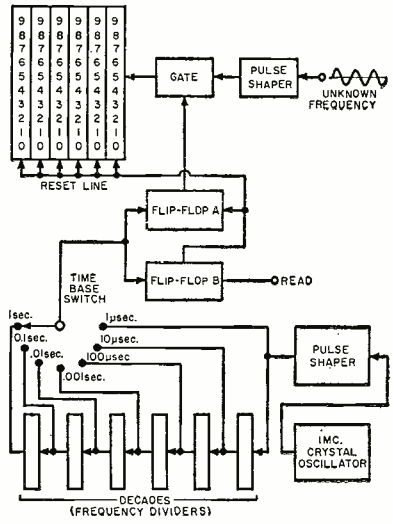
When it receives the next pulse from the time-base generator, flip-flop *B* switches back to the *zero* condition. The output pulse from the right-hand tube of flip-flop *B* is used to reset the counting decades and also to reverse flip-flop *A*. Reversal of flip-flop *A* opens the gate circuit until, one second later, another pulse arrives from the time-base generator. This pulse switches flip-flop *A* back to the *zero* condition and closes the gate. However, during the 1-second interval during which the gate is open, the counters at the top of Fig. 8 will read the number of pulses of the unknown frequency.

To repeat the frequency measurement, another *read* pulse must be fed to flip-flop *B*. If *read* pulses are applied at regular intervals, the frequency measurement will be repeated periodically and will indicate the drift, if any, in the frequency being measured. A series of *read* pulses can be developed by additional decades receiving input pulses from the time-base generator. —30—

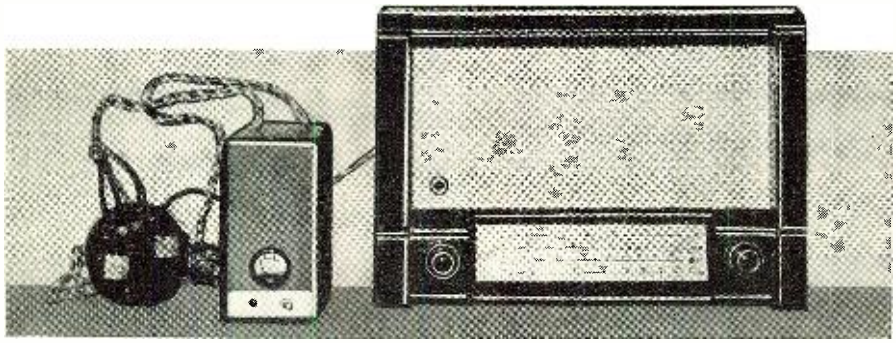


← **Fig. 7. The schematic of a representative gate circuit. There will be output from V_3 only when both of its input grids are above cut-off simultaneously.**

Fig. 8. Block diagram of circuit used for accurate frequency measurements. Lower portion of diagram shows circuit used to provide accurate timing of start and stop pulses. These are compared to the unknown signal. →



Russian Receiver Powered By Kerosene Lamp



Round jack and switch box for various power connections and the vibrator power supply with built-in voltmeter are shown to the left of Russian set.

Subsidized set built for Middle East use operates for 8 to 16 hours on about one quart of fuel.

THE Russian broadcast set shown above was built as a "poor man's radio" for the Middle East to enable the residents of these countries to pick up Russian radio broadcasts. The set is subsidized in that the buyer is given a partial refund on the purchase price so that the final cost amounts to about the equivalent of $45. Even with the refund the price is pretty steep for most of the would-be buyers. This, coupled with the fact that kerosene is expensive and hard to come by in Middle East countries, has made acceptance of the set pretty limited.

The idea of using heat, such as from a kerosene lamp, to generate a voltage to run a set is novel but it is not new. Several European countries have tried and discarded this method during World War II and before. For example, the English had a somewhat similar rig in the early thirties, using flame from a gas jet rather than a kerosene lamp, but the units were troublesome and impractical.

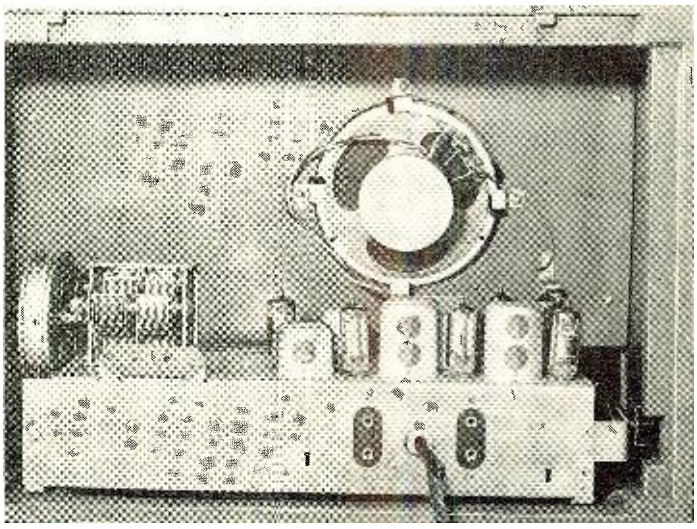
The thermocouple, mounted between the lamp's aluminum radiating fins, produces an output of 1.2 volts. This is used for the filaments of the tubes and to drive a vibrator power supply. The output of the vibrator supply is 90 volts for tube plates and screens. The radio will continue to play even though lowered heat reduces the thermocouple voltage to about 0.8 volt.

The radio itself is a 7-tube, 4-band superhet. It covers a frequency range from 175 kc. to 12.3 mc. Two concentric-type controls on the right are for bandswitching and tuning, while two other concentric-type controls on the left are for tone and volume. The pilot lamp is at the lower left corner of the grille. When batteries are available, these can be used to power the set directly. The thermocouple and external power supply would then not be needed.

A heavy 5-inch speaker is used, and this, coupled with the push-pull output stage, produces fairly good output. Provision is made for an external speaker and phono pickup. Trimmer adjustment holes in the shield cans are covered with discs of red gummed paper to prevent tampering.

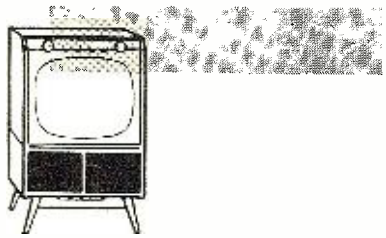
The chassis is made of heavy gauge aluminum, bent into *U* or channel-shape with mounting straps riveted to the corners. The cabinet is made of solid eucalyptus, or blue gum, with a beautiful hand-rubbed finish, however, from the inside it looks as if it had been chopped out with a dull hatchet. —30—

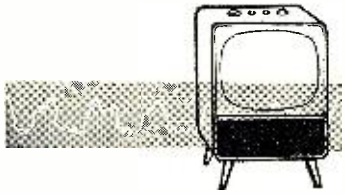
The "Thermo-electro Generator TGK-3" not only supplies heat and light but may also be used to cook some borsch in a pan placed atop the radiating fins. The wire lead from the built-in thermocouple is shown.

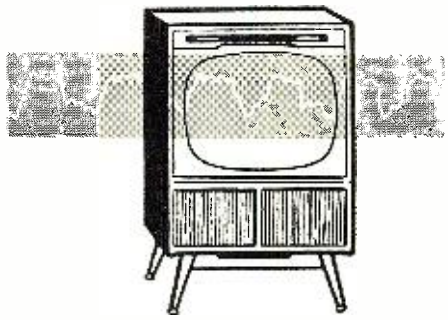


Rear view shows set to be a conventional design. Speaker is a 5" unit with heavy magnet. Miniature glass tubes are used. Beside the power cable are pin jacks for an external speaker and phono input.

"Sound" Advice for TV







By **BOB ELDRIDGE**

One meter plus a little ingenuity enables good, rapid TV sound alignment on transmitted signals.

IT IS GOOD practice to make a routine check of the sound alignment of every TV set on the bench before packing up the chassis for delivery back to the customer. When the procedure has become a habit, it is so easy that five minutes will see the whole operation through, and it is seldom that a set is not improved soundwise by this little extra attention.

One thing which dissuades the technician from making "uncalled for" sound alignments is the fact that the manufacturer's schematic often makes the job seem complicated by calling for the use of a two-resistor jig, clipped or tacked across the ratio detector output, before making the final adjustment. This is a tiresome detail, and not always simple to accomplish physically—conventional clips seem gigantic when you try to connect them to tube sockets without shorting between adjacent pins! A casual inquiry among benchmen revealed that this "attach-a-jig" business is the thing which really puts them off doing an instrument check. Alternatively, the initial adjustments are made by meter and the ratio-detector transformer secondary slug is then adjusted by ear "halfway between buzz or distortion points."

Let us give this matter a little thought. What do we use the jig for anyway? Fig. 1 shows a pair of 100,000-ohm resistors ready to be clipped across the ratio detector load. When they have been clipped on, we are instructed to connect a v.t.v.m. between points *B* and *C* and then adjust the ratio-detector secondary slug for zero volts on the meter.

Once this has been done, point *C* is at the center of a voltage-divider network, so the voltage between *C* and ground is half that between *A* and ground. When we have completed the adjustment, the voltage at *B* is the same as that at *C* (since there is zero-volt potential between them). So why not dispense with the jig and adjust the coil so that the voltage between *B* and ground is half that between *A* and ground?

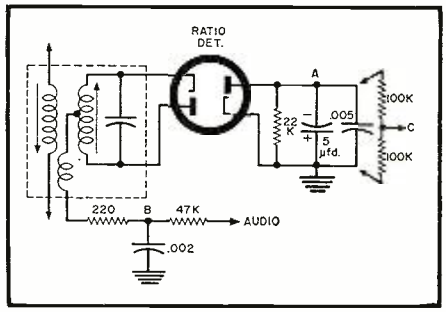


Fig. 1. Conventional TV ratio detector.

The alignment then becomes a straightforward 1-2-3-4 deal, with the common probe of the v.t.v.m. attached permanently to ground, and no test clips or resistors to mess with. In most cases, it is not necessary to refer to the schematic and point *A* can be located merely by looking for the electrolytic capacitor which always filters the ratio-detector load.

Now we can sum up a quick, routine sound alignment procedure:

1. Tune in a signal, the weaker the better, turning the fine-tuning control well over "into the picture," that is, well away from the sound carrier, with fine detail in the picture being reduced. This will weaken sound amplitude, as we wish, and just goes to show how clever we were to think of doing this at all! If we wish to make the sound even poorer we can temporarily disconnect one or both sides of the antenna lead-in.

2. Find the filter capacitor across the ratio-detector load and connect the d.c. probe of the v.t.v.m. to this capacitor's ungrounded end. Switch the meter to the −d.c. or +d.c. function, depending on capacitor polarity. The 50-volt range of the meter will usually be fine.

3. Adjust the sound take-off coil for maximum voltage reading.

4. Adjust the limiter or i.f. stage (if there is one—some sets omit this stage) for maximum voltage.

5. Adjust the ratio-detector primary (usually the bottom slug) for maximum reading.

6. Note the voltage obtained after adjustment in the preceding step. Next transfer the meter's d.c. probe to the center tap of the ratio-detector transformer—or any point connected to this center tap. This will be the already mentioned point *B* of Fig. 1. Now adjust the transformer secondary for *exactly half the voltage you obtained in the last step.* For accuracy, you may wish to repeat steps 5 and 6.

If you are the skeptical type, you can connect a speaker and listen for the rich, bell-like tone described in the manufacturer's literature. It isn't really necessary, but some people like to be sure.

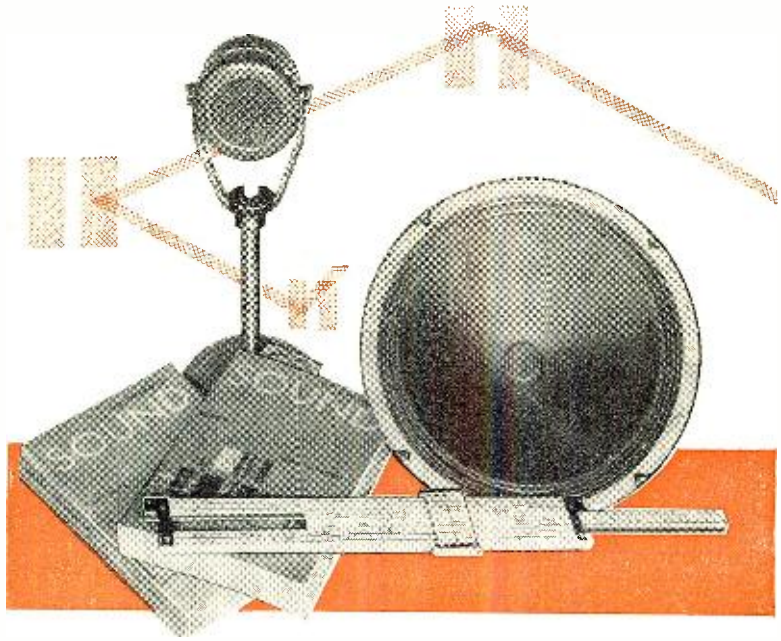
Noisy Sound in the Home

It is often automatically assumed that good, clear FM sound and optimum AM rejection will always occur at the same point of adjustment of the ratio-detector transformer's secondary. This will only be true if the *primary* is correctly tuned.

For example, the customer's com-

(*Continued on page* 103)

Testing the Properties of Loudspeakers



By **J. L. SMITH**
Collins Radio Co.

Simple tests and measurements require little more equipment than a.c. voltmeter and audio oscillator.

WHAT are the properties of loudspeakers which influence their ability to reproduce faithfully and efficiently? Mass, compliance, flux density, acoustic output are terms which enter the conversation when this question is answered. But how can these properties be measured? Precise and accurate measurements on loudspeakers are difficult and expensive, requiring skill and specialized equipment. We can be less rigorous, however, and make simple measurements which will clearly demonstrate many of these interesting properties of speakers. Some of these tests have been collected and are presented here. These tests have been simplified as much as possible and require only equipment which is available to the average technician and experimenter. These tests will be directed toward the acoustical portion of the reproducing system.

In making these tests remember that a loudspeaker is a carefully made unit. Do not tamper with the mechanism of an expensive unit. If any alterations are to be attempted, be sure to try your ideas first on an inexpensive unit. The tests described in this article, however, will not injure your speaker if reasonable care is exercised.

For the purpose of this article the acoustical portion of an audio system will be that apparatus between the secondary of the output transformer and the listener's ear. We will be concerned with the loudspeaker proper, its baffle, and the characteristics of the listening room.

A loudspeaker is an electro-acoustic device, so we cannot entirely divorce ourselves from the electrical portion of the audio system. As a matter of fact, we will make as many tests and measurements as possible with electrical equipment because it is more easily handled.

Speaker impedance vs frequency measurements: The accepted method of measuring impedance is, of course, with an impedance bridge which will indicate the resistance and reactance of the loudspeaker. In the absence of such a bridge, however, the magnitude of the impedance can be determined very simply by the voltage comparison method. The schematic of the test method is shown in Fig. 1. The maximum value of R is not critical as long as it is about ten times the nominal impedance of the loudspeaker. It is convenient to place a knob and scale on R and calibrate the scale in ohms with an ohmmeter. An audio tone of 400 cps from a test record or audio oscillator is then fed into the amplifier and the gain adjusted until a convenient deflection is obtained on the voltmeter (about three-quarters scale) with switch S in position 1. S is then placed in position 2 and R adjusted until the voltmeter reads the same in positions 1 and 2. The value of R will then be the magnitude of the speaker impedance at 400 cps. A typical plot of impedance *vs* frequency of a free speaker is shown in Fig. 8.

If it is desired to determine the resistive and reactive components of the loudspeaker impedance when no bridge is available, the method just described may be employed by first tuning out the reactive component. See Fig. 2 for connections.

Above the resonant frequency, the speaker impedance is composed of resistance and inductance. The effect of the reactance can be cancelled by adding, in series with the speaker, a reactance of opposite sign, *i.e.*, above cone resonance add series capacity. To determine the impedance, adjust R for maximum resistance, then vary C for a minimum reading of the voltmeter with S in position 1. Once this minimum has been obtained, proceed as previously outlined to adjust for equal voltages across the speaker and the resistance. The impedance of the speaker is then the value of resistance indicated by R plus a reactance equal to the reactance of the capacitor but with the sign reversed, that is, it is inductive. For example, if at 100 cps a capacity of 50 μfd. is necessary for the minimum reading with S in position 1 and equal voltages appear across the resistance and loudspeaker with an R of 5 ohms, the impedance of the speaker is found to be:

$$Z_s = R + jX_c = 5 + j32 \text{ ohms}$$

Notice that the sign of the reactance has been reversed. This measuring procedure can be repeated for different frequencies.

If only the relative impedance curve

COIN	WEIGHT—(grams)
Dime	2.50
Penny	3.05
Nickel	5.05
Quarter	6.40
Half-dollar	12.35
Silver dollar	26.70

Table 1. Weights of common U. S. coins.

Table 2. Sound absorption at 512 cps.

MATERIAL	COEFF.
Wood sheathing (varnished)	.03
Concrete	.016
Carpet	.25
Cork floor (waxed)	.05
Draperies	.35
Acoustic Celotex	.7
Upholstered chair	1.6
Adult person	4.2
Glass	.027
Sheetrock	.03
Open window	1.0
Couch	4.8

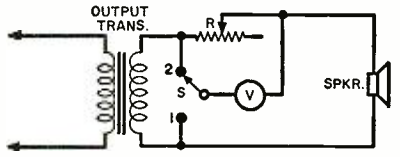


Fig. 1. Determining the impedance.

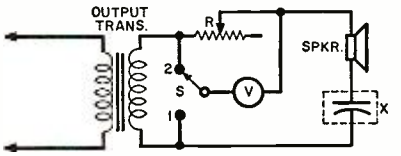
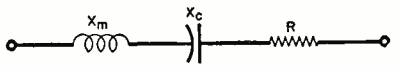
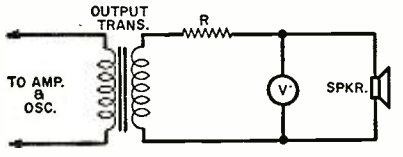


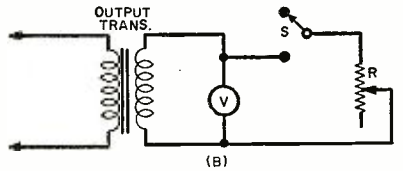
Fig. 2. Finding the resistive component.



← Fig. 3. Simplified equivalent circuit.



(A)



(B)

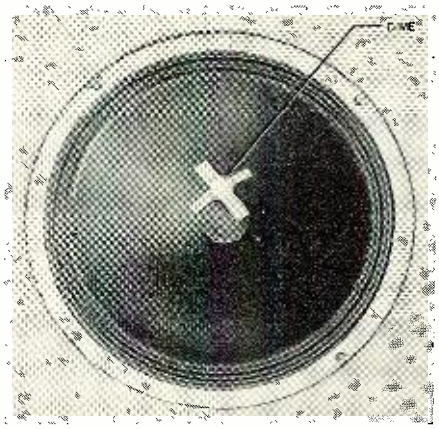
Fig. 4. (A) Determination of resonant frequency and (B) the source impedance.

is desired, it can be obtained by using the setup of Fig. 4A. Here R is noncritical as long as it is large compared to the nominal speaker impedance. As the frequency is varied throughout the desired range, the voltage measured on the voltmeter will be in proportion to the speaker impedance.

Source impedance: The magnitude of the impedance of the source which the speaker sees can be determined very easily by the half-voltage method. Electrical connections are shown in Fig. 4B. An audio tone is fed into the amplifier and the gain adjusted to give a convenient small voltage reading with switch S open. The switch is then closed and R is adjusted until the voltmeter reads half its original value. The value of R is then the magnitude of the source impedance. Source impedance is an important factor in loudspeaker damping.

Speaker resonance: Once an impedance curve has been run on a loudspeaker, the resonant frequency is quite obvious. Examination of Fig. 8 shows the resonant frequency to be that frequency at which the peak occurs, about 140 cps in this example. If it is necessary to know the resonant frequency only, to design a bass reflex enclosure for example, the scheme shown in Fig. 4A can be used very simply. The frequency of resonance is indicated by a peak in the voltage reading as the frequency is varied.

Fig. 5. Dime taped to the speaker cone.



Mass and compliance of speaker cone: In its most simple form, the loudspeaker can be represented as a series LCR circuit, as shown in Fig. 3. X_m, called the mass reactance, is determined by the mass of the cone. X_c, called the compliance reactance, is determined by the stiffness of the suspension system. R is the equivalent resistive component and is the result of the electrical losses and the radiation resistance of the loudspeaker. X_m and X_c are generally much larger than R so the point of resonance will occur when $X_m = X_c$ or:

$$2\pi f_r M = \frac{1}{2\pi f_r C}$$

This equation can be solved for f_r and yields the familiar equation:

$$f_r = \frac{1}{2\pi\sqrt{CM}} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where: f_r is the speaker resonant frequency in cps
M is the speaker cone mass in grams
C is the compliance of the suspension system in centimeters per dyne

Now f_r can be simply determined as has been described earlier. If either M or C is now altered, a new resonant frequency f_r' will be obtained. This will provide us with two equations in two unknowns, M and C, and these unknowns can be readily solved.

The compliance of the speaker cannot be altered readily but the mass of the vibrating cone may be changed by taping a small weight to the inner apex of the cone. See Fig. 5. Use only enough weight to give a significant change in resonant frequency. Too large a weight will make it impossible to detect resonance. Be sure to attach the extra mass securely with masking tape so that it does not rattle. After the extra mass, M', has been added, the new resonant frequency will be:

$$f_r' = \frac{1}{2\pi\sqrt{C(M+M')}} \quad . \quad . \quad . \quad (2)$$

Equations (1) and (2) can be solved simultaneously for C and M to yield:

$$C = \frac{\left(\frac{f_r}{f_r'}\right)^2 - 1}{4\pi^2 M' f_r^2} \text{ cm/dyne} \quad . \quad (3)$$

and

$$M = \frac{M'}{\left(\frac{f_r}{f_r'}\right)^2 - 1} \text{ grams} \quad . \quad . \quad . \quad (4)$$

where: M' is the added mass in grams
f_r is the original resonant frequency
f_r' is the resonant frequency after the mass has been added

As an illustration, a certain 4" loudspeaker was found to have a natural resonance of 155 cps. A ½-gram weight, made up of a small crescent of #18 wire and the masking tape necessary to attach this weight to the cone, lowered the resonant frequency to 130 cps. When this information is inserted in equations (3) and (4) the mass of the cone is calculated to be 1.19 grams and the compliance 8.9×10^{-7} cm/dyne.

Flux density of the air gap: The efficiency, power handling capabilities, and general performance of a loudspeaker are related to the flux density, B, of the air gap times the length of wire, L, comprising the voice coil. In all but relatively few cases the term BL will appear rather than the quantity B alone. For that reason it will be sufficient to determine the product BL in our measurements and not be concerned with individual values. A simple way to make this measurement is to take advantage of the fact that the force exerted on a current-carrying conductor is:

$$F = BLI \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where: F is the force in dynes
B is gap flux density in gausses
L is the length of wire on the voice coil in centimeters
I is the current flowing in the voice coil in abamperes (10 amps.)

We can measure this force with the arrangement shown in Figs. 6 and 10. The speaker is placed cone upward on a table or other flat surface. A battery, milliamp meter, and a variable resistor are connected in series with the voice coil so that a controlled current can be caused to flow in the voice coil. A thin cardboard disc is placed in the apex of the cone to provide a flat bottom. A small plumb-bob type weight is suspended on a string above the cone. With no current flowing in the voice coil, the plumb bob is adjusted to hang so that it just touches the cardboard disc at a point near the disc edge. A small known weight, such as a coin, is placed in the center of the cardboard disc. This will cause the cone to be depressed a certain distance depending on the weight of the coin. A depression of 1/32" or so will be sufficient. Current is now passed through the voice coil in such a direction as to raise the cone towards its original position. The current is adjusted so that once again the plumb bob just touches the edge of the cardboard disc. We have now balanced the $F = BLI$ equation. We know the mass of the added weight and can read the current flowing in the voice coil so the product of flux density times length becomes:

$$BL = 9.8 \times 10^6 \left(\frac{M}{I}\right) \text{ gauss-cm} \quad . \quad (6)$$

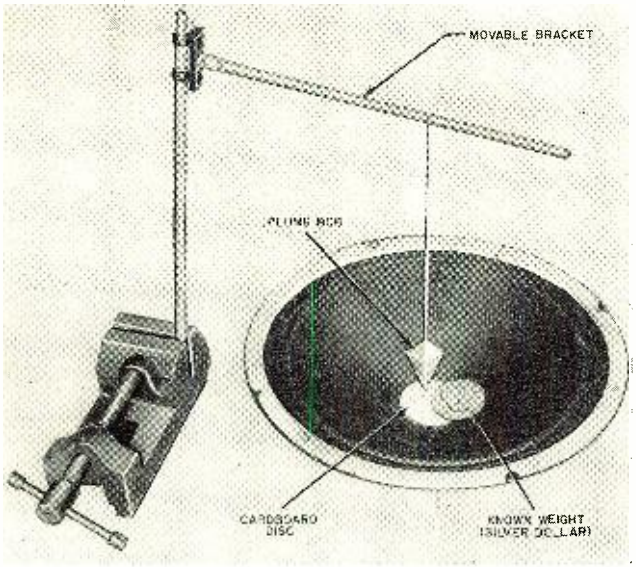


Fig. 6. Physical arrangement for determining flux density.

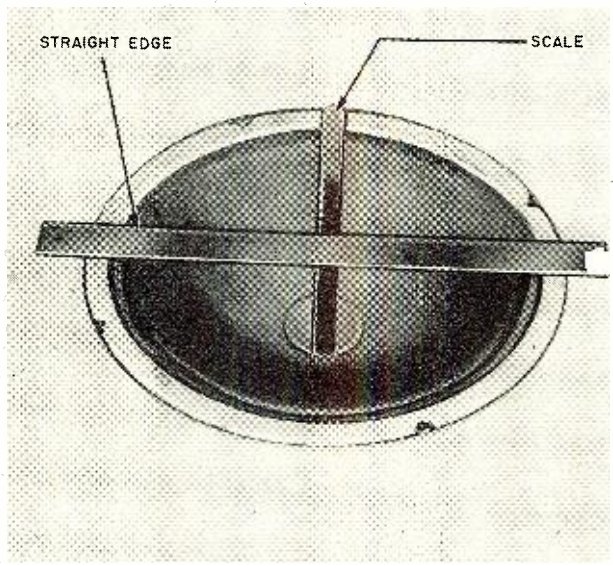


Fig. 7. Cone depth measuring arrangement for cone travel.

where: M is the added mass in grams
I is the voice coil current in milliamps

The term 9.8×10^6 is included to convert to proper units. An approximation of the length of wire on the voice coil can be made by measuring the d.c. resistance. 30 cm-per-ohm will get you close.

Linearity of cone travel: If the flux density of the air gap is not uniform throughout the distance traveled by the voice coil or if the flux does not adequately cover the path traveled by the voice coil, the force applied to the cone through the driving mechanism will not represent the true shape of the voice coil current. This, of course, results in a non-linearity and, consequently, distortion. Non-linearity can also be caused by driving the speaker cone beyond the suspension limits of the suspension system. A static plot of cone displacement *vs* voice-coil current can be obtained with the same electrical connections shown in Fig. 10. Again the speaker is placed cone upward on a flat surface and the cardboard disc is placed in the apex of the cone as described previously. Instead of using the suspended plumb bob arrangement, however, a straight-edge is placed across the diameter of the speaker basket. A good scale is used to measure the distance from the top surface of the cardboard disc to the lower edge of the straight-edge. See Fig. 7. The distance is first measured with no current flowing in the voice coil. As a small current is caused to flow through the voice coil this distance is again measured. This procedure is repeated until the maximum current of the speaker is reached. Maximum current is determined from $I = \sqrt{P/Z}$ where P = power rating of the speaker and Z is the impedance of the speaker. The current is reduced to zero and the connections to the voice coil reversed. The measurements are repeated for the reversed polarity. A plot similar to Fig. 9 will be obtained. The cone will faithfully reproduce the waveform of the current flow if the plot is a straight line. Curvature near the extremes indicates non-uniform flux density or over extension of the suspended system.

Speaker efficiency: The speaker efficiency is one hundred times the ratio of acoustic power output to electric power input. A simple method for determining the efficiency of a speaker is described in reference 1 and attributed to Kennelly & Pierce. The electrical power delivered to the loudspeaker when operating normally is the product of the current squared times the resistive part of the loudspeaker impedance. The acoustic power delivered by the loudspeaker can be found by subtracting the electrical losses from the power input. Electrical losses can be found by blocking the speaker cone with shims so that movement is impossible and then measuring the resistive component of the speaker impedance under these conditions. The product of current squared times this resistive component represents the electrical losses of the speaker. The acoustic power is then the difference between total electrical power input and the electrical power losses. The efficiency equation becomes:

$$n = \frac{r_f - r_b}{r_f} \times 100 \quad . \quad . \quad . \quad . \quad (7)$$

where: n is the speaker efficiency
r_f is the resistive part of the speaker impedance with the cone itself free
r_b is the resistive part of the speaker impedance with the cone firmly blocked

A convenient adaptation of this method is easily achieved with the electrical connections shown in Fig. 11. The oscillator is set at a frequency well above the natural speaker resonance. C is adjusted for minimum voltage across the speaker-capacitor series circuit.

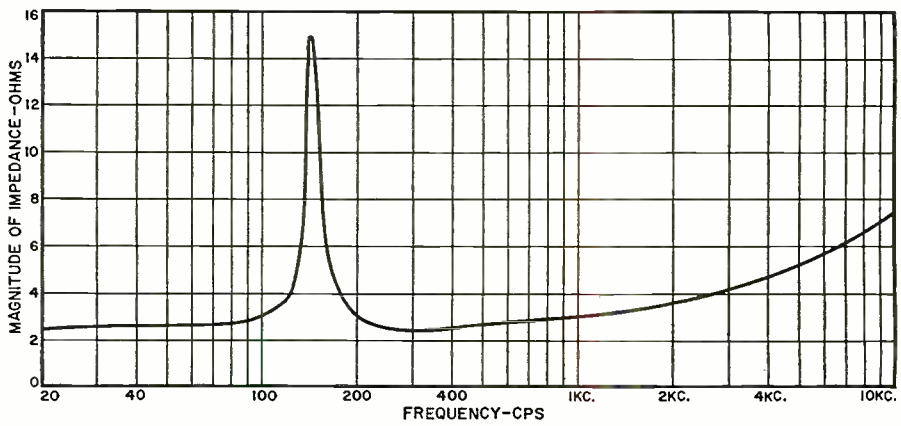
This minimum voltage is noted as E_r. The cone is blocked and C again adjusted for minimum voltage across the speaker-capacitor series. This minimum is noted as E_r'. If R is large, it can be shown that equation (7) can be closely approximated by:

$$n = \frac{E_r - E_r'}{E_r} \times 100 \quad . \quad . \quad . \quad (8)$$

where: n, E_r and E_r' carry the notations mentioned above.

In one instance, R was made 1000 ohms and twelve volts of 2400—cps

Fig. 8. Shown below is an impedance plot of a typical 4-inch loudspeaker.



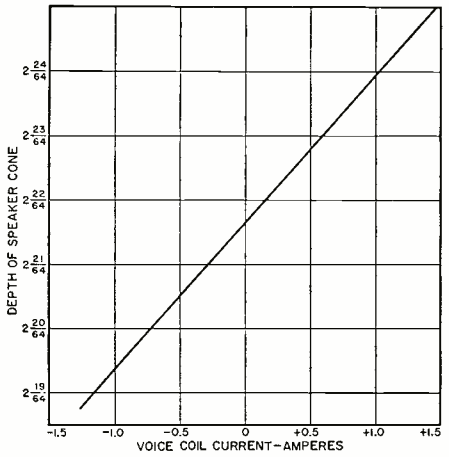


Fig. 9. Cone displacement of 10" speaker.

voltage was applied from the oscillator. A minimum of .1 volt across the speaker and capacitor was observed when C was adjusted to 10 μfd. The cone was blocked and a minimum of .09 volt observed when C was adjusted to 14 μfd. In this case $E_r = .1$ volt and $E_r' = .09$ volt. From equation (8) the efficiency can be calculated to be 10% at 2400 cps.

Similar determinations can be made at other frequencies. As frequency is lowered, the value of capacitance necessary for a minimum becomes larger. An infinitely large capacitor is indicated at the natural resonant frequency of the speaker. There are several factors which affect the accuracy of this method. Not the least of these is the large possible error contributed in measuring when E_r' is nearly equal to E_r. This method also assumes mechanical losses negligible.

Speaker response: To take a speaker response curve the arrangement shown in Fig. 12 may be used. The oscillator must supply constant output to the speaker over the range of frequencies which interest you and the response of the microphone and amplifier must be known. It is true that this is asking a lot, for few of us have calibrated microphones lying about. In general, however, a broadcast quality microphone will be so much better than the average loudspeaker that it may be assumed to be flat. If it is desired to calibrate the microphone (and it is a worthwhile endeavor), several methods are available. A unique method is described in reference 3 as the "Reciprocity Technique of Calibration." This method is reasonably simple and does not require any more test equipment than is necessary for other tests described in this article. The process is quite lengthy so we will not go into the details but will refer the reader to Meyer[3] should he be sufficiently interested. Because the characteristics of the room will affect the response as measured by this arrangement, the microphone should be placed about one foot along the axis of the speaker. A reference is set at 400 cps and the frequency varied above and below this point and the reading of the db meter is noted. The response can then be plotted.

Multiple speakers: When multiple speakers are used, care must be taken to insure the proper phasing of the units. Out-of-phase speakers tend to counteract each other's efforts. A very simple method for checking the phasing of speakers is to connect a flashlight cell across the speaker leads and observe the direction of travel of each cone. All cones should travel outward at the same polarity. Reversing the voice-coil connections will reverse the direction of travel for a given battery polarity. Do not forget to phase both tweeter and woofer in a dual system. There will be frequencies in the region of crossover which will be reproduced by both. If a horn-type tweeter is used or if cone movement is not discernible, phasing can be done by using the two speakers as microphones and phasing for maximum output.

In a woofer-tweeter combination the selection of a crossover point should be governed by the low-frequency unit. The acoustic output of a speaker will be constant up to that frequency at which the cone no longer vibrates as a piston. This is called the break-up frequency of the cone. For a rigid cone this frequency is governed by the expression:

$$f_b = \frac{v}{2\pi R} = \frac{2100}{R} \quad . \quad . \quad . \quad . \quad (9)$$

where: f_b is the break-up frequency in cps

v is the velocity of sound in inches per second (13,200)

R is the radius of the speaker cone in inches

A rigid 15" cone has a break-up frequency of 280 cps. For this reason wide-range speakers have concentric compliance rings formed into the cone to allow only a small portion of the cone to vibrate at the higher frequencies. This gives the advantage of a large cone at low frequencies and a small cone at the higher frequencies. The crossover point may be any point below that where piston action ceases. This frequency may be calculated from equation (9) where the radius of the smallest compliance ring is used for R. Once the choice of crossover point has been made, suitable crossover network design can be found in almost any reference book. Reference 2 provides excellent instructions, including coil winding information. Be sure to use as large wire as possible in the inductors to keep the resistive losses low.

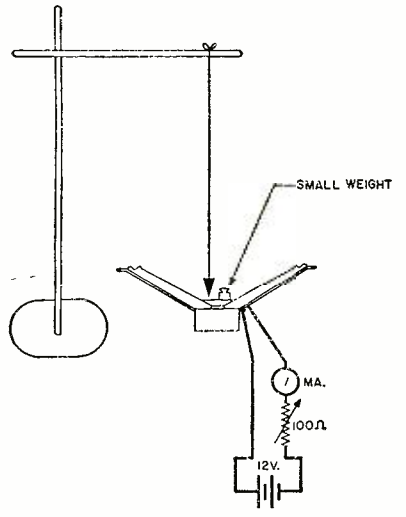
Speaker enclosures: Speaker enclosures may be divided into three general classes; infinite baffle, horn, and vented port or reflex. The infinite baffle makes an effort to separate the acoustic radiation at the rear of the speaker from that of the front. The horn-type baffle makes similar efforts and, in addition, an attempt is made at matching the radiation impedance of the speaker to the air load by means of the horn.

The bass-reflex cabinet not only has an adjustment which will vary performance but one which is mandatory for top performance. This is the tuned port which should be adjusted for the particular speaker to be used.

The bass-reflex cabinet is essentially a Helmholtz resonator tuned to the resonant frequency of the loudspeaker. See Fig. 14A. A simplified electrical equivalent circuit of a loudspeaker in such an enclosure is shown in Fig. 13. The speaker appears as a series-resonant circuit and the cabinet as a parallel-resonant circuit. If the cabinet is adjusted so as to have the same resonant frequency as the speaker, the effects of each tend to cancel. The result is an impedance curve having two humps of equal magnitude spaced equidistant on either side of the speaker resonant frequency. It appears as though the cabinet were of higher "Q" than the speaker and just notches out a portion of the resonant energy of the speaker in a manner not unlike the action of an absorption-type wavemeter. This notch can be moved along

(*Continued on page* 124)

Fig. 10. Electrical and physical arrangement for the measurement of flux density.



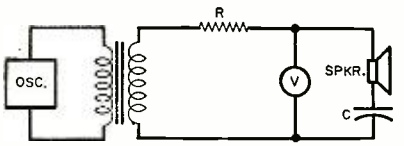
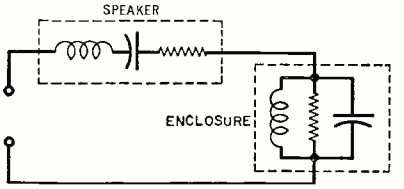


Fig. 11. Finding the speaker efficiency.

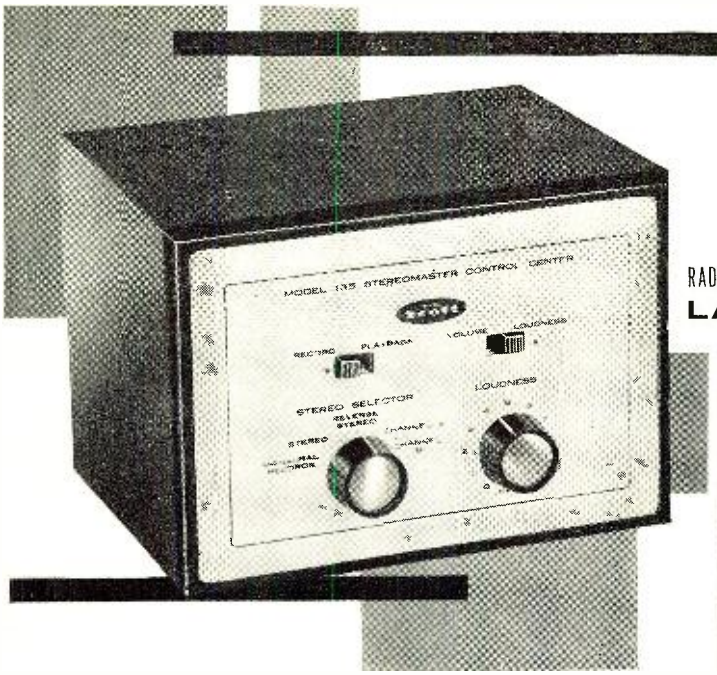
Fig. 12. Setup used to check response.

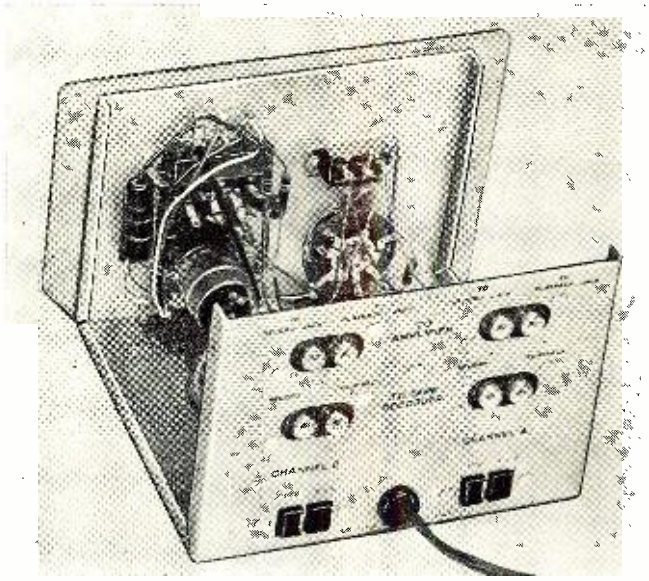
Fig. 13. Simplified equivalent circuit of speaker in reflex type of enclosure.



A Stereo Control Unit

RADIO & TV NEWS LAB TESTED





Front view of the stereo control center is shown above. The rear panel is shown in the view at the right where the cover has been removed in order to show the internal parts assembly.

Versatile master gain and switching unit may provide the "missing link" for the stereophile's setup.

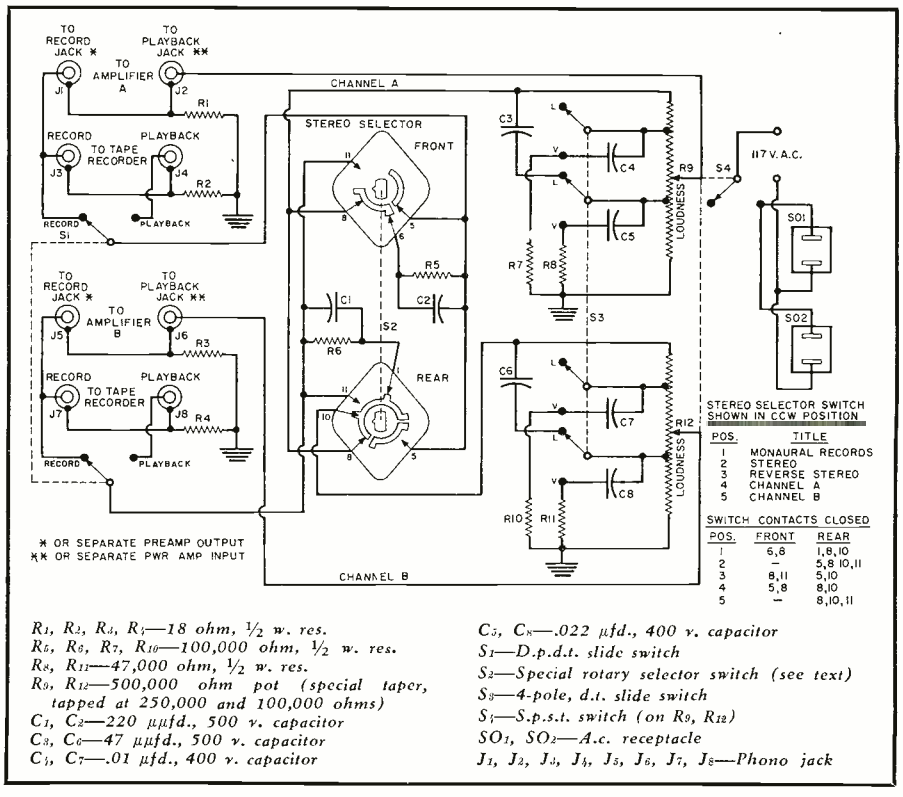
FOR the audiophile who wants to graduate to stereo, this *Scott* stereo control center may provide the important missing link. Suppose you already have two separate preamps, power amplifiers, and speaker systems that you'd like to arrange into a stereo setup. Now it's true that you could feed one stereo channel through one of the two systems, with the other channel going through the other system. But this would introduce a few problems. First, there would be no way of adjusting the levels of both systems simultaneously; you would have no master level control. Second, if you wanted to play a single (monaural) channel through both your speaker-amplifier systems, you would have to arrange a jury-rig switching scheme. The unit shown above will do all this and more with a simple turn of a knob.

Although the control center has been designed specifically for *Scott* amplifiers, whose appearance it matches, it can also be used with any hi-fi system with separate preamps and power amplifiers, or with two identical amplifiers with tape input and output connections. Here is what the unit will do when it is properly hooked up. The power switch on the loudness control applies line voltage to both amplifiers that are plugged into the control center (see Fig. 1). A ganged loudness control adjusts the levels of both channels at the same time. Thus, once the system is balanced, the outputs from both speaker systems can be adjusted together. The loudness control may be converted to an ordinary volume control by operating slide switch S_3. This simply removes bass and treble boost capacitors C_3 to C_8 from the circuit.

The heart of the control center is the 5-position selector switch. In the first position, as shown on the schematic, both input jacks (J_1, J_5) are connected to both loudness control sec-

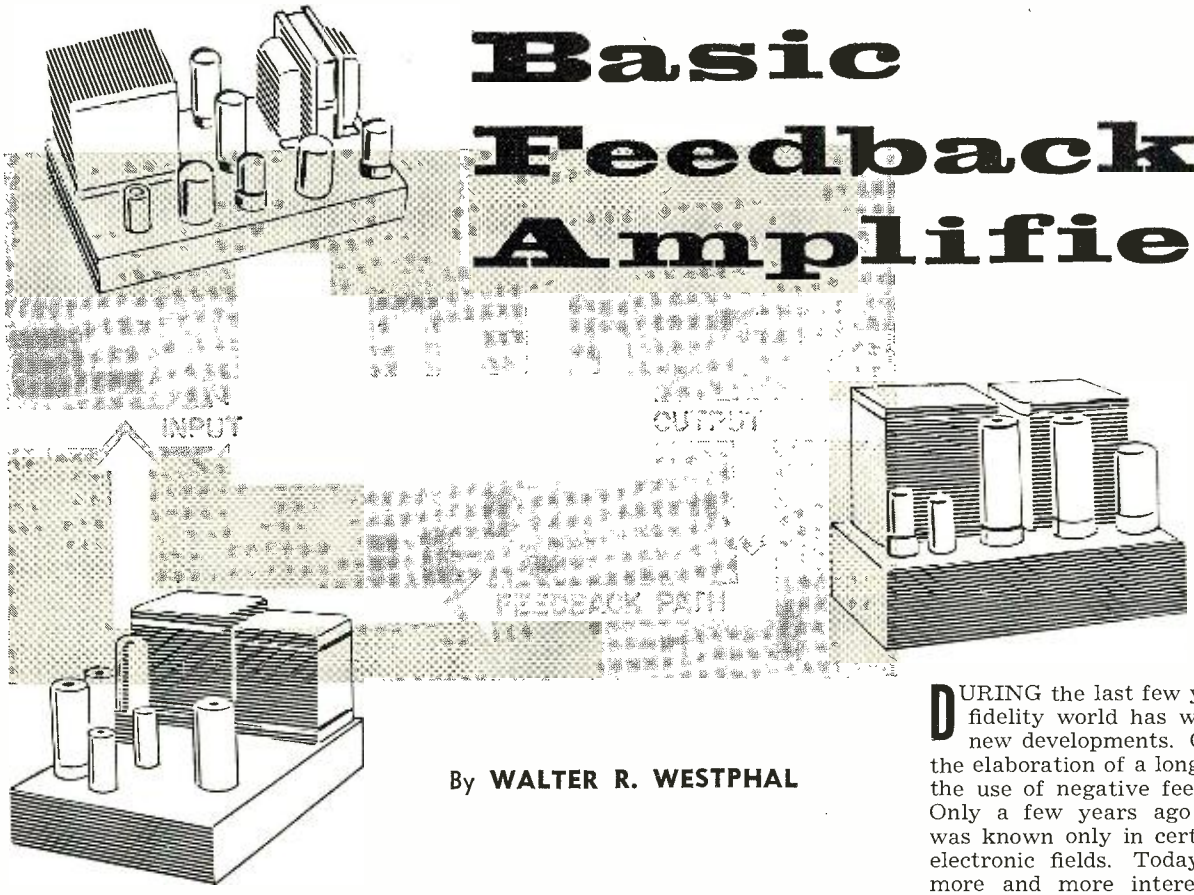
(*Continued on page 120*)

Fig. 1. Note that no tubes are employed in this stereo control center.



R_1, R_2, R_3, R_4—18 ohm, ½ w. res.
R_5, R_6, R_7, R_{10}—100,000 ohm, ½ w. res.
R_8, R_{11}—47,000 ohm, ½ w. res.
R_9, R_{12}—500,000 ohm pot (special taper, tapped at 250,000 and 100,000 ohms)
C_1, C_2—220 μμfd., 500 v. capacitor
C_3, C_6—47 μμfd., 500 v. capacitor
C_4, C_7—.01 μfd., 400 v. capacitor
C_5, C_8—.022 μfd., 400 v. capacitor
S_1—D.p.d.t. slide switch
S_2—Special rotary selector switch (see text)
S_3—4-pole, d.t. slide switch
S_4—S.p.s.t. switch (on R_9, R_{12})
SO_1, SO_2—A.c. receptacle
J_1, J_2, J_3, J_4, J_5, J_6, J_7, J_8—Phono jack

Basic Feedback Amplifiers



By **WALTER R. WESTPHAL**

A review of basic principles for the audiophile and experimenter, who use these circuits widely.

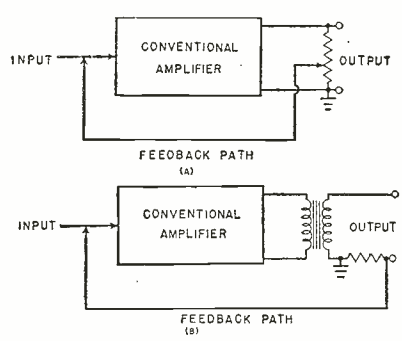


Fig. 1. A conventional amplifier with (A) voltage and (B) current feedback.

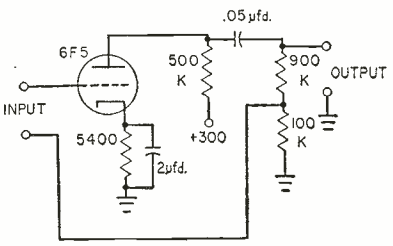


Fig. 2. Here is a 6F5 triode voltage amplifier with a voltage feedback circuit. The signal voltage that is developed across the 100,000-ohm resistor is out-of-phase with the input signal and thus partially cancels it.

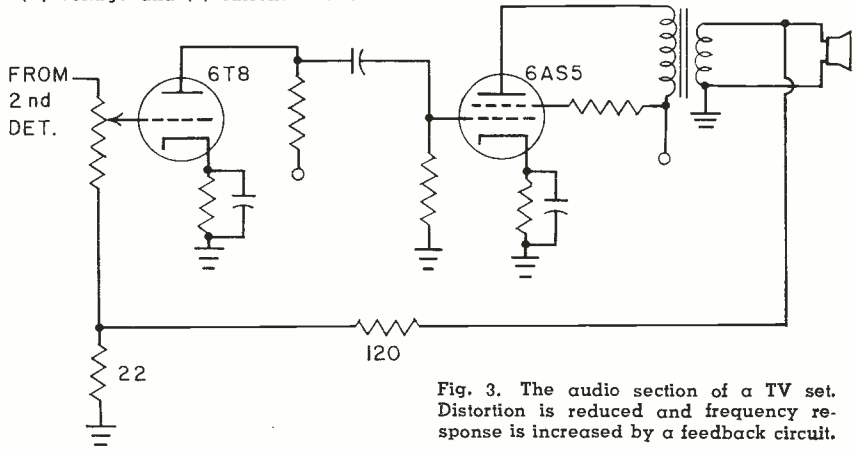


Fig. 3. The audio section of a TV set. Distortion is reduced and frequency response is increased by a feedback circuit.

DURING the last few years the high-fidelity world has witnessed many new developments. One of these is the elaboration of a long existing idea; the use of negative feedback circuits. Only a few years ago this circuitry was known only in certain specialized electronic fields. Today, by contrast, more and more interested hobbyists are becoming aware of its applications and characteristics. Future designs will probably show an even greater tendency toward the use of negative feedback circuits and the experimenter and audiophile should be acquainted with some of the more common circuits.

The growing demand for reduced distortion and increased frequency response is becoming the key factor in amplifier design. The trend toward feedback amplifiers is a direct result of this demand. As will be pointed out, other factors are also of interest but to many persons the most important characteristics are increased frequency response and reduced distortion. Modified loudspeaker damping, increased circuit stability, and reduced gain are some of the other considerations which should not be overlooked when analyzing a circuit's operation. First of all, let's look at the effect of feedback on signal distortion.

The output of an amplifier is usually not a perfect replica of the input waveform. Consequently, the output of any amplifier contains a certain amount of distortion. Most of this is due to the fact that a vacuum tube is not a linear device, especially when the changes in current are very large as is the case in an audio power amplifier. Distortion can be reduced by applying part of the output signal back to the input but out-of-phase with it. This is negative feedback. The amount by which the distortion is reduced depends upon the amount of signal voltage fed back. The larger this voltage, the greater the reduction

in distortion. But there is a practical limit to this as the gain of the amplifier is reduced accordingly. However, this loss in gain can be compensated for in other ways, such as providing more gain in the initial design.

If the voltage fed back to the input of an amplifier is in-phase with the input signal then the gain is increased and this process is known as positive feedback or regeneration. Some table model radios employ positive feedback to increase the amplification even though it has some undesirable features. This is essentially the operation which takes place in an oscillator.

A feedback amplifier is a conventional vacuum tube or transistor amplifier with the addition of a feedback circuit. The circuit used to provide feedback can be classified as either voltage feedback or current feedback depending upon how this signal is obtained. Fig. 1 shows this by means of two block diagrams; (A) showing a typical voltage feedback circuit and (B) showing the manner in which negative current feedback may be achieved. In Fig. 1A, the amplified voltage across the output resistor is 180° out-of-phase with the voltage at the input. Part of this amplified signal is then fed back to the input of the amplifier. This will reduce the total input voltage depending upon the amount of signal that is fed back. This signal is proportional to the output voltage and gives this particular circuit its name. In Fig. 1B, the signal fed back is also out-of-phase with the voltage at the input but is proportional to the current flowing in the output.

Both voltage and current feedback have the same effect with respect to reduced distortion and improved frequency response, the only difference being in the effect that feedback has on the tube's internal plate resistance. This feature plays an important part in some electronic circuits, such as cathode-follower and grounded-grid amplifiers.

The circuit required to provide negative voltage feedback is quite simple. Fig. 2 illustrates this with a triode voltage amplifier. The amplified output signal appears across the two series resistors (the 900,000- and 100,000-ohm units). One-tenth of this voltage, by voltage divider action, appears across the 100,000-ohm resistor and is fed back to the input where its effect is to reduce the total grid-to-cathode voltage. This factor, one-tenth, is known as the feedback factor and is represented by the Greek letter β (*beta*). If the feedback factor is negative, as it is in this case, β is a negative number.

A tube manual would indicate that this stage normally has a gain of 70 without feedback, that is, if the input signal is 0.1 volt, the output signal would be 7 volts. But feedback reduces the gain of this stage to only 8.75.

The formula for the gain of an amplifier with feedback is as follows:

$$A' = A/(1-\beta A)$$

where A' is the gain with feedback; A is the gain without feedback; and β is the feedback factor.[1]

It might seem at first that this is a tremendous reduction in amplification, but the advantages will far outweigh this loss. For example, suppose that the total harmonic distortion of this stage was 5% before feedback was applied. One of the advantages of negative feedback is to reduce the distortion and, in this case, the total distortion would be less than one-half of one per-cent. The range of flat frequency response is also found to be increased. Taking the same 6F5 triode stage shown in Fig. 2, suppose the frequency response had been 80 to 10,000 cycles. With β equal to 1/10, the response might now be 8 to 80,000 cycles.

Fig. 3 shows the a.f. stages of a popular-make TV set. The feedback loop extends over two stages; from the output of the 6AS5 power amplifier to the input of the 6T8 voltage amplifier. This practice of using two or three stages has been found to result in optimum characteristics. The output signal is developed across the 120-ohm and 22-ohm resistors in series. Because the 22-ohm resistor is also part of the input circuit, feedback results.

The addition of negative current feedback to an amplifier can be even simpler than negative voltage feedback. Removing the cathode bypass capacitor from a stage results in degeneration or negative feedback. Fig. 4A shows a triode amplifier in which the cathode bias resistor has not been bypassed, resulting in a loss in gain. The advantages of current feedback are the same as for voltage feedback; the only difference being the change in tube plate resistance mentioned earlier. The amount of feedback can be controlled by varying the portion of the cathode resistor left unbypassed. Fig. 4B shows a stage in which the feedback is reduced from that of Fig. 4A. Note that the bias voltage will be the same value in each case because the d.c. component of plate current must flow through 1000 ohms but the feedback factor in (B) will be reduced by approximately one-half. An alternate method of providing current feedback is shown in Fig. 5. Again the signal fed back is proportional to the current flowing in the output. In this circuit the input signal is developed across R_1 and R_2 to ground. But part of the output signal is also developed across R_2. These signals will tend to cancel each other. Result: negative feedback.

The use of feedback amplifiers is not new in industrial electronic applications. World War II spurred their use in devices such as radar, guidance systems, computers, etc. The reduction in harmonic, frequency, and phase distortion as well as the improved circuit stability were prime factors in their utilization. The cathode follower, for instance, is a good example

(*Continued on page* 119)

[1] Many authorities call the entire quantity (1 - βA) the feedback factor, while still others use this term for the quantity β A.—Editor.

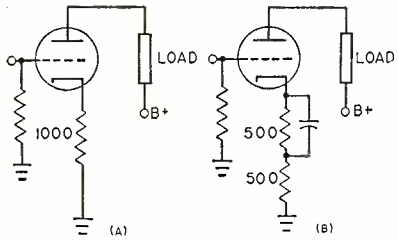


Fig. 4. Negative feedback is obtained by means of unbypassed cathode resistor. Operation is the same in both cases but feedback factor in (B) is ½ that in (A).

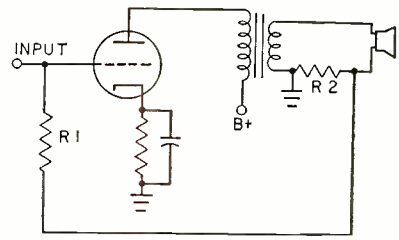


Fig. 5. The relationship between the resistance of R_2 and the impedance of the loudspeaker load determines the amount of degenerative feedback here.

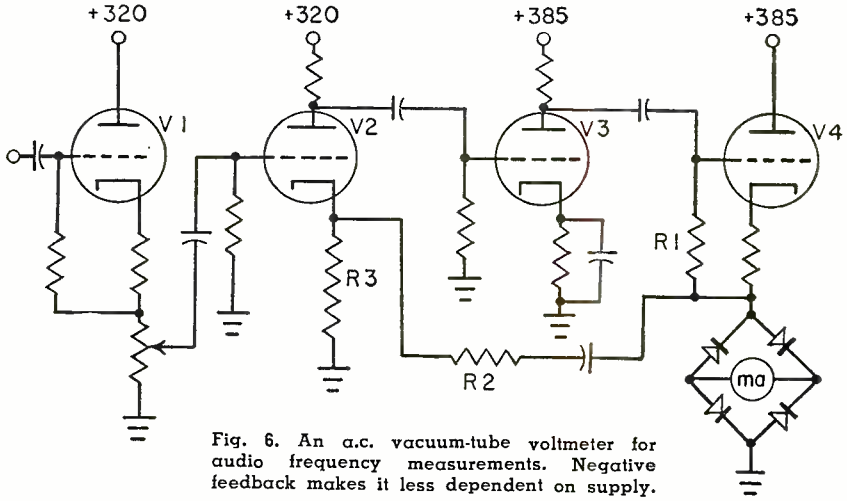
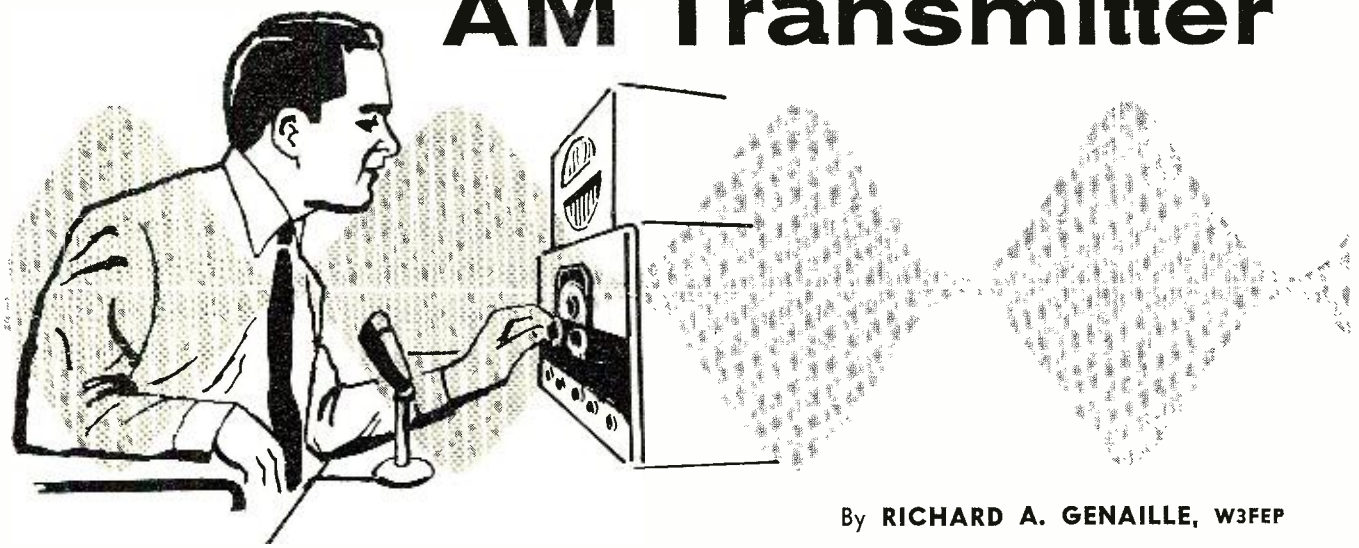


Fig. 6. An a.c. vacuum-tube voltmeter for audio frequency measurements. Negative feedback makes it less dependent on supply.

Shun-Fed Modulation For Your AM Transmitter



By **RICHARD A. GENAILLE, W3FEP**

Little used ham modulation method provides increased flexibility in modulating that low-or high-power final.

SEVERAL years ago, the author made the mistake of attempting to modulate his 500-watt phone transmitter without the benefit of a load on the secondary of the modulation transformer. As anyone who has ever made this costly error can tell you, it didn't take much more than "Hello" into the microphone to send a 250-watt modulation transformer to join its ancestors. Of course, someone is going to say that anyone who doesn't have the necessary protection built into his transmitter to preclude such disasters deserves to lose a modulation transformer; however, there are many fine commercially manufactured ham transmitters on the market today that do not provide these safety features and there are many amateurs who dislike engineering a ham transmitter to death.

The purpose of this article is to illustrate a little-used method, among amateur operators, which makes possible a considerable range of choice in selecting modulation transformers for an amateur radiotelephone transmitter. Your problem of modulating that low- or high-power final amplifier, replacing defective modulation transformers, or designing your new AM transmitter can be simplified considerably by the knowledge and application of shunt feed in your audio system. You may also be able to save yourself quite a few dollars by using components from the shack junkbox.

Being faced with the problem of replacing the defunct modulation transformer and not having the necessary funds available to purchase same, it was decided to dig into the junkbox to see what, if anything, could be made to work. A modulation transformer originally used in the familiar ART-13 autotune airborne transmitter, manufactured by *Collins,* was discovered. This transformer, which has a fixed turns ratio, has two secondary windings; one for the r.f. amplifier plate and one for the screen. The ART-13 transmitter utilized push-pull 811's in class B to modulate a single 813 r.f. amplifier. The author's transmitter consisted of push-pull 813's in the r.f. amplifier operating with 1500 volts on the plates at a little over 500 watts input. The class B modulator tubes were 805's with the same plate voltage as the 813's. It was found that the turns ratio of the ART-13 modulation transformer was just about perfect for a match between the 805's and the 813's. Well, the matching problem was solved but it was ridiculous to think that this little modulation transformer, with a nameplate rating of 50 watts, could deliver the audio power necessary to 100% modulate the 500-watt final amplifier. Besides, neither of the secondaries could safely carry the final amplifier plate current. That did it. It looked as if the rig would be off the air for some time until the necessary $30 or so could be shaken loose from the family piggy-bank.

With the rig off the air, it seemed like a good time to catch up on my technical reading. Maybe this would be a good time to make the transition to SSB or, better yet, why not do some c.w. work for a change. The move to SSB was out of the question for the same reason that a new modulation transformer could not be purchased and c.w. had lost its charm after the first three or four years of "brass pounding." What to do?

While thumbing through the audio section of one of the handbooks to find a cheap and dirty way of modulating the transmitter, an interesting circuit was discovered. Here was a schematic showing shunt feed of audio to an r.f. amplifier. Why had I not thought of that before? This has been done almost since the time that commercial broadcast transmitters first came into existence. Why should I worry about too much current through the secondary of my surplus modulation transformer when I can shunt the final amplifier plate current through a choke? This way I won't have any r.f. amplifier plate current going through the secondary. No d.c. through the secondary should practically eliminate the heating problem.

The standard arrangement for class B plate modulation of an r.f. amplifier is shown in Fig. 1. Fig. 2 shows the shunt-feed arrangement. The r.f. amplifier plate supply in the author's transmitter contained both a swinging and a smoothing choke. It was decided that the power supply could get along very nicely without the smoothing choke, without objectionable lack of filtering and that the smoothing choke might possibly be used as the audio isolation choke. The defunct modulation transformer was removed and the ART-13 modulation transformer was installed. The transformer has a test voltage rating of 4000 volts but to insure against a.f. break-

downs to the case, four 1-inch stand-off insulators were used to mount the new transformer. As shown in Fig. 2, the smoothing choke (L) was simply relocated in the circuit and used as the audio choke while the bleeder resistor and output filter capacitor were reconnected in the circuit just after the swinging choke. The arrangement of Fig. 2 permits the class C amplifier plate current to be fed through the modulation choke in contrast to running the current through the secondary of the modulation transformer as shown in Fig. 1. The use of an adequate sized choke for L and a capacitor of moderate size for C improves the low-frequency response over that of the circuit shown in Fig. 1. For this reason, the shunt-feed arrangement is commonly used for commercial broadcast transmitters. One might say that the improved low-frequency response is of no value from the standpoint of a ham transmitter. This is usually true; however, to avoid the undesirable slope or "cant" on clipped speech waveforms resulting from phase differences throughout the modulator, it is necessary that the audio system, after clipping and filtering, have good low-frequency response. The lows can be eliminated in the early stages of the speech amplifier that is used.

Choke L in Fig. 2 should have an inductance high enough to give an inductive reactance at least equal to the class C amplifier load impedance at the lowest frequency to be modulated. Capacitor C should have a capacitive reactance much lower than the class C amplifier load impedance at the lowest audio frequency to be transmitted. The shunt-feed arrangement will give improved phase-shift characteristics for clipped speech waveforms over the usual plate modulation system shown in Fig. 1. The coupling capacitor (C) shown in Fig. 2 should have a voltage rating at least equal to the highest d.c. plate supply voltage impressed upon it and should be of the oil-filled type. Impedance matching is accomplished as per usual. The shunt feeding does not change anything as far as securing the proper impedance match is concerned. In the author's transmitter, capacitor C was insulated from the chassis by means of 1-inch stand-off insulators to insure against breakdowns.

The system just described has been in operation at the author's station, W3FEP, for over two years and was originally installed when the old call was W5RSN. The total operational time is almost 5 years during which no trouble has ever been encountered with the modulation system. The transmitter has been operated continuously for periods of up to 29 hours during the annual Sweepstake and DX contests with no audio system failures. At the time of the original change to shunt feed, the writer had some misgivings about the length of time that the "little ole" ART-13 modulation transformer would hold up and a spare was obtained for a rainy day. The spare transformer is still in the box it came in and it doesn't appear as if it will ever be needed as a replacement. Another bonus was obtained through the use of this particular transformer since it was designed specifically for voice communication and the frequency rating of the transformer is from 400 to 4000 cycles. Undoubtedly there are many surplus modulation transformers of low power-handling capabilities still kicking around that were originally designed for voice work that could be used very satisfactorily in low- or high-power AM transmitters by using the shunt-feed system. While the author's arrangement makes use of one particular transformer, there is no reason why a commercial 50-watt multi-tap transformer could not be substituted. On the basis of the 50-watt rating transformer being capable of delivering the necessary audio for modulating the 500-watt r.f. amplifier, it would appear that a 100-watt transformer could be used for obtaining the necessary audio to modulate a 1-kilowatt r.f. amplifier or a 10-watt transformer could be used for obtaining 50 watts of audio. One of the problems often encountered in modulating a low-voltage, high-current type of r.f. amplifier is that many of the commercially available modulation transformers cannot safely handle the high current through the secondary. This necessitates the use of a transformer of a higher power rating which is not only wasteful but costly as well. Running the r.f. amplifier plate current through the choke, which was previously used in the power supply filter section and consequently can handle the r.f. amplifier plate current plus, reduces the heating of the modulation transformer due to the high secondary current. The d.c. potential existing *between* the primary and secondary of the modulation transformer in the author's transmitter is zero since the same voltage is used on the class B modulator as is used on the class C r.f. amplifier. Insulating the case of the transformer from the chassis insures against d.c. and a.f. voltage breakdown from the windings to the case of the modulation transformer.

For the information of those amateur operators who might wish to modulate their 500-watt push-pull 813 final amplifiers, the author's circuit parameters are as follows: push-pull 813's r.f. final amplifier, 1500 volts at 375 ma., plate-load impedance is 4000 ohms; push-pull 805's class B modulator, 1500 volts at 400 ma. on peaks, −16 volts bias, and plate-to-plate load impedance of 8200 ohms.

In Fig. 2, C is a 4 μfd., 1500 volt oil-filled capacitor while L is a 15 henry, 500 ma. filter choke. The modulation transformer is a surplus ART-13 modulation transformer or a commercial 50-watt unit. The screen winding on the ART-13 modulation transformer is not used. The primary-to-secondary turns ratio is 1 to .695 step down.

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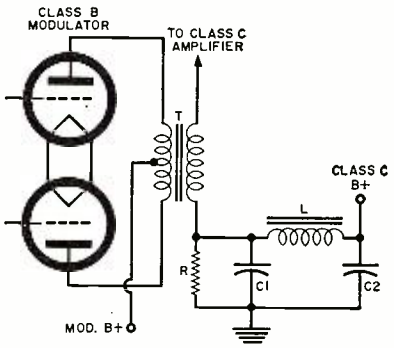
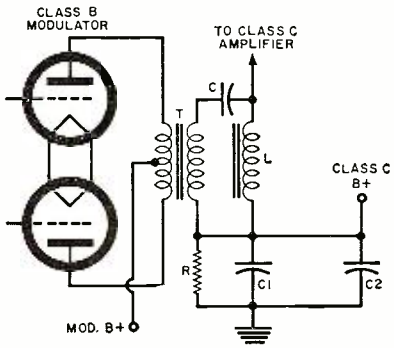


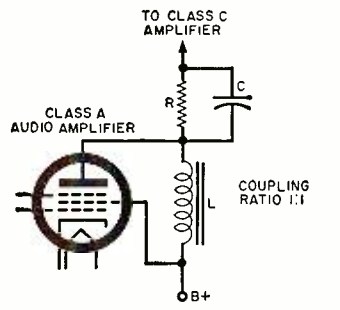
C1,C2-POWER SUPPLY FILTER CAPACITORS
L-POWER SUPPLY SMOOTHING CHOKE
R-POWER SUPPLY BLEEDER RESISTOR
T-MODULATION TRANSFORMER

Fig. 1. Class B plate modulation circuit.

Fig. 2. Shunt-fed class B plate modulation.



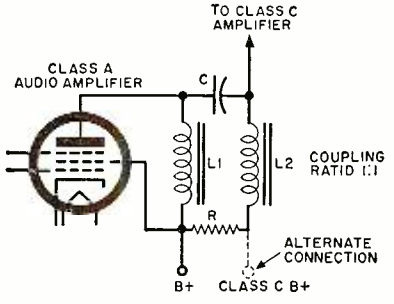
C-COUPLING CAPACITOR (OIL)
C1,C2-POWER SUPPLY FILTER CAPACITORS
L-MODULATION CHOKE (FORMERLY POWER SUPPLY SMOOTHING CHOKE)
R-POWER SUPPLY BLEEDER RESISTOR
T-MODULATION TRANSFORMER



C-AUDIO BYPASS CAPACITOR
L-AUDIO CHOKE (L MUST HAVE A HIGH IMPEDANCE AT AUDIO FREQUENCIES)
R-DROPPING RESISTOR (ADJUSTED FOR 100% MODULATION)

Fig. 3. Partial schematic diagram showing the choke-coupled (or Heising) plate modulation system described above.

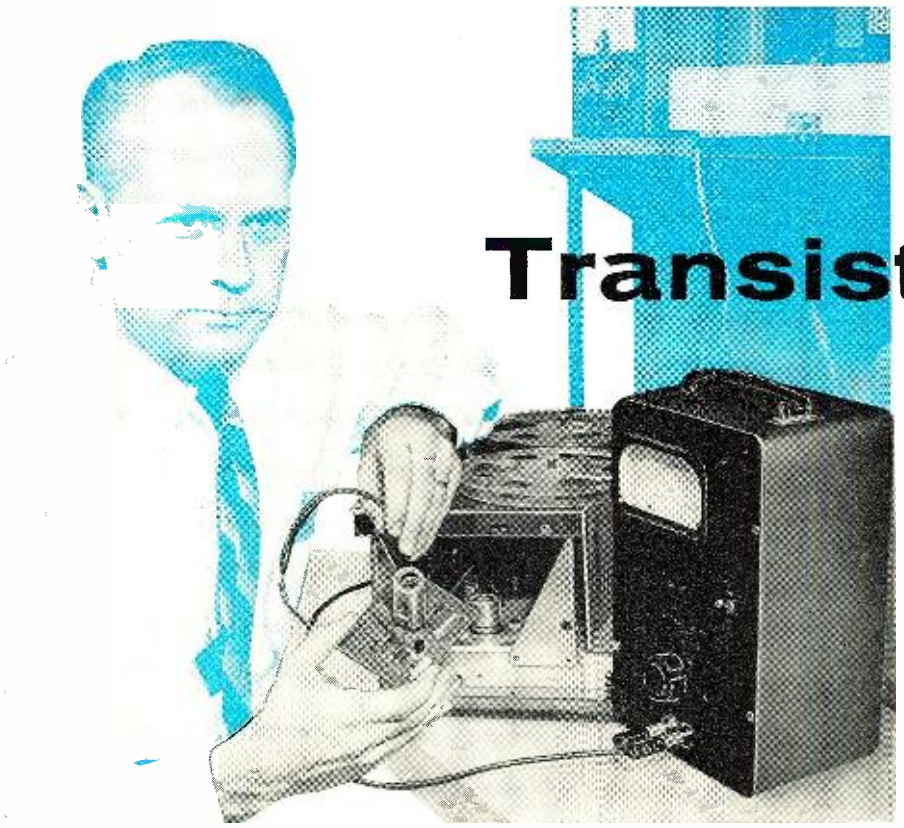
Fig. 4. Shunt-fed choke-coupled Heising modulator. The alternate connection is made if resistor R is not used in circuit.



C-COUPLING CAPACITOR (OIL)
L1,L2-AUDIO CHOKES
R-DROPPING RESISTOR (ADJUSTED FOR CORRECT CLASS C AMPLIFIER PLATE VOLTAGE)

By **DWIGHT V. JONES**
Semiconductor Products Dept.
General Electric Co.

Transistor-Tube Tape Preamp



The author is checking his preamplifier before installing it in his tape recorder.

Neither microphonics nor heater hum plague the low-level stage of this hybrid tape preamplifier.

IN A tape recorder circuit, the input stage from the tape head offers the greatest inducement to transistorization. Tubes may degrade performance because of microphonics, hum from heaters, and the low signal-to-noise ratio at low frequencies. The dynamic range of an amplifier is decreased as the noise level increases, thus the preamplifier usually becomes the limiting factor in a tape recorder.

The transistor is not plagued by microphonics or heater hum and, in addition, offers an improvement in the signal-to-noise ratio. While the cost of transistor stages remains above that involving tubes, the use of a transistor in conventional circuits results in certain advantages that often offset this price differential.

With vacuum tubes, the signal transfer from the tape head involves only a voltage transfer whereas transistors require power. Fig. 2 demonstrates the transfer of recorded information on the tape, in the form of changing magnetic flux (ϕ), to an electrical signal at the output of the tape head. From Fig. 2 we see that the output signal current *decreases* with increasing frequency and as the head inductance is increased. The output signal voltage amplitude *increases* with frequency and head inductance. Vacuum tubes make use of the output signal voltage exclusively, thus we can see why the NARTB tape playback equalization standard requires approximately 35 db of bass boost for constant amplitude output. See Fig. 1.

Fig. 1 illustrates the problem, mentioned earlier, of obtaining a suitable signal-to-noise ratio at low frequencies when tubes are employed. For instance, at 50 cycles the amplifier is required to provide maximum gain with the signal close to the noise level at this frequency.

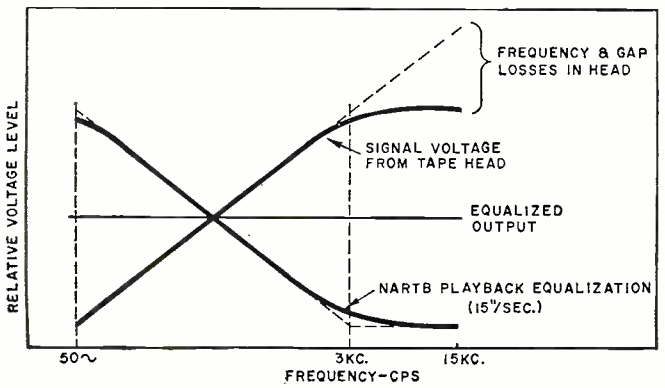


Fig. 1. Response curves showing the output signal voltage directly from the tape head along with the standard playback equalization required in order to obtain flat output.

Transistors provide more flexibility since they can make use of a signal voltage, current, or a combination of the two. The type of signal transfer from the head depends on the load impedance, as shown in Fig. 3. If current transfer is used, we have problems at the higher frequencies that are similar to those encountered with tubes at the lower frequencies. See the curves of Fig. 2. If we could match the load to the tape head impedance at all frequencies we would then have the maximum power transfer and, consequently, a good signal-to-noise ratio at all frequencies. With a matched load, as indicated in Fig. 3, one-half of the generator voltage is transferred across the load while one-half of the current from the current generator goes into the load. From the curves of Fig. 2 we can see that if we transfer one-half of both the current and voltage, the output will be more uniform at all frequencies of operation.

In practice, it is usually not convenient to match the head at more than one frequency. In addition, it is desirable in a hybrid circuit to utilize most of the available transistor gain to achieve the highest signal level possible at the tube input for good signal-to-noise ratio. This requirement precludes equalizing or using feedback for changing the input impedance of the transistor input stage.

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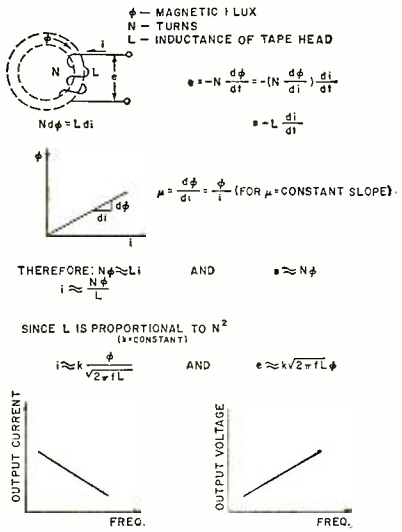


Fig. 2. Variations in output current and voltage for magnetic tape head.

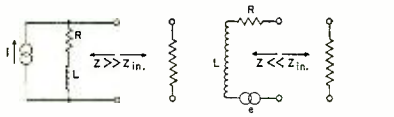


Fig. 3. The type of signal transfer from the tape head depends on the load.

IMPEDANCE RANGE OF AVAILABLE TAPE HEADS

	50~	1KC.	15KC.
HIGH —	300Ω	6KΩ	75K
LOW —	5Ω	100Ω	1.5K

Fig. 4. Impedances available in commercial tape heads now on the market.

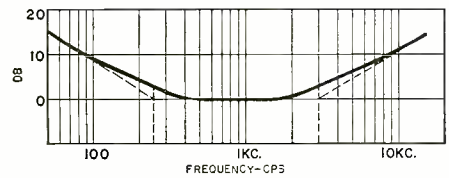
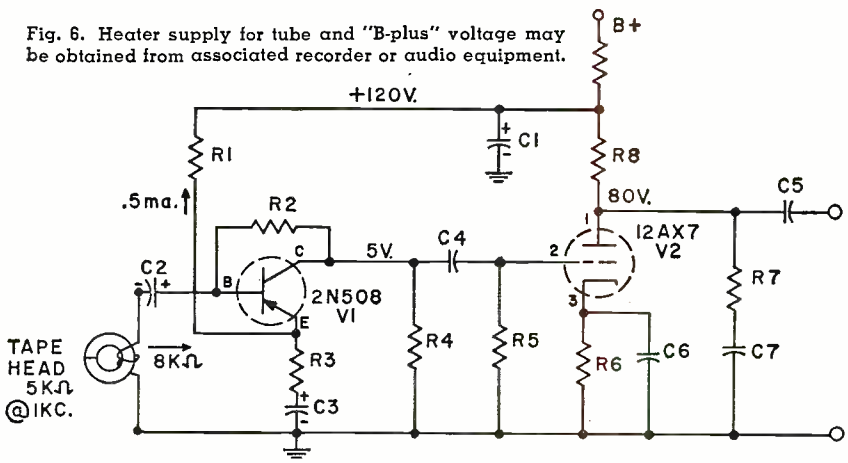


Fig. 5. Graph of the equalization needed to compensate the signals across R_1.

Fig. 6. Heater supply for tube and "B-plus" voltage may be obtained from associated recorder or audio equipment.



R_1—220,000 ohm, ½ w. res.
R_2—1 megohm, ½ w. res.
R_3—27 ohm, ½ w. res.
R_4—10,000 ohm, ½ w. res.
R_5—2.2 megohm, ½ w. res.
R_6—4700 ohm, ½ w. res.
R_7—22,000 ohm, ½ w. res.
R_8—220,000 ohm, ½ w. res.

C_1—10 μfd., 250 v. elec. capacitor
C_2—10 μfd., 15 v. elec. capacitor
C_3—100 μfd., 15 v. elec. capacitor
C_4—.1 μfd., 200 v. ceramic capacitor
C_5—.05 μfd., 200 v. ceramic capacitor
C_6—.01 μfd., 200 v. ceramic capacitor
C_7—.02 μfd., 200 v. ceramic capacitor
V_1—"p-n-p" transistor (G-E 2N508)
V_2—½ 12AX7 tube

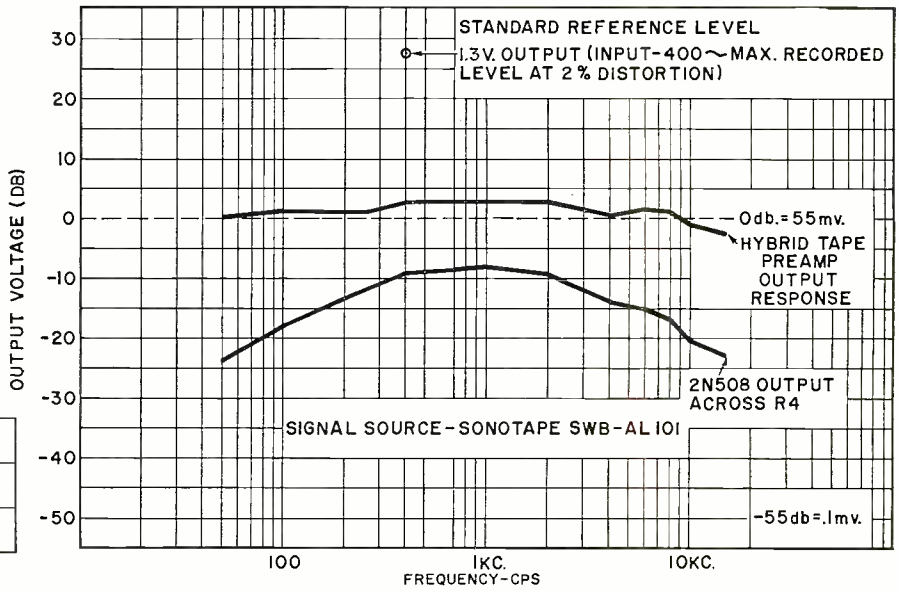
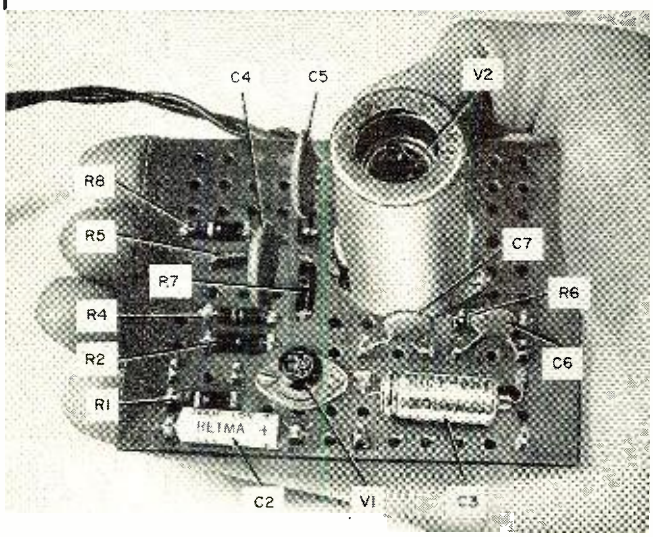
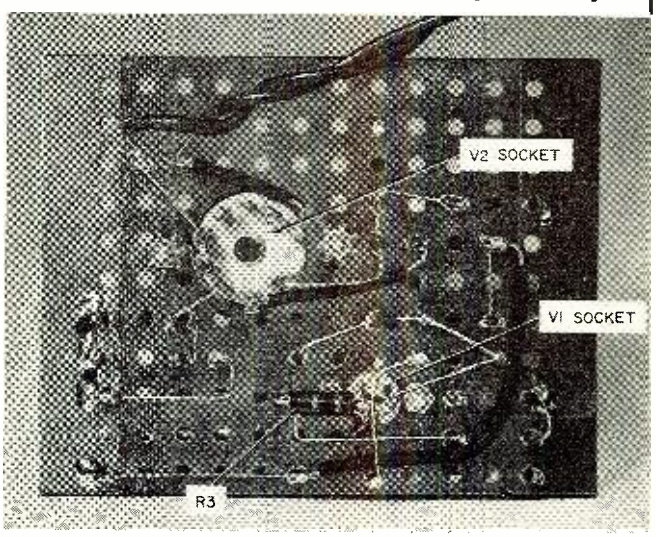


Fig. 7. The output across the load resistor of the transistor stage (lower curve) must be equalized by the 12AX7 stage in order to produce upper curve.

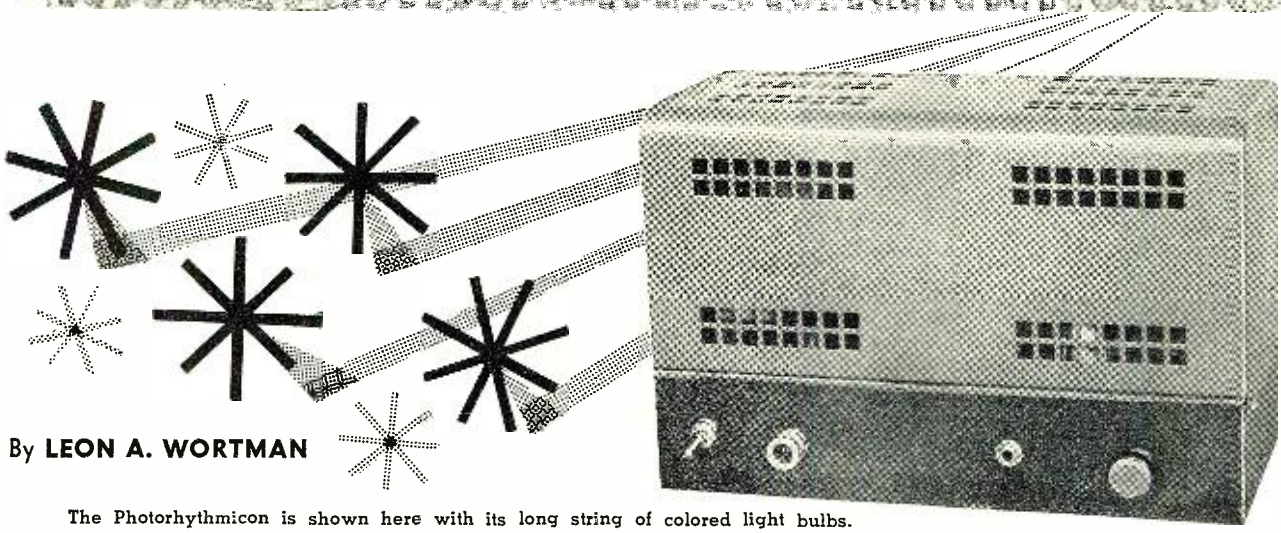
Top view of the hybrid unit showing mounting of components.



Bottom view of the tape preamplifier showing the wiring.



"PHOTORHYTHMICON"-Dancing Lights



By **LEON A. WORTMAN**

The Photorhythmicon is shown here with its long string of colored light bulbs.

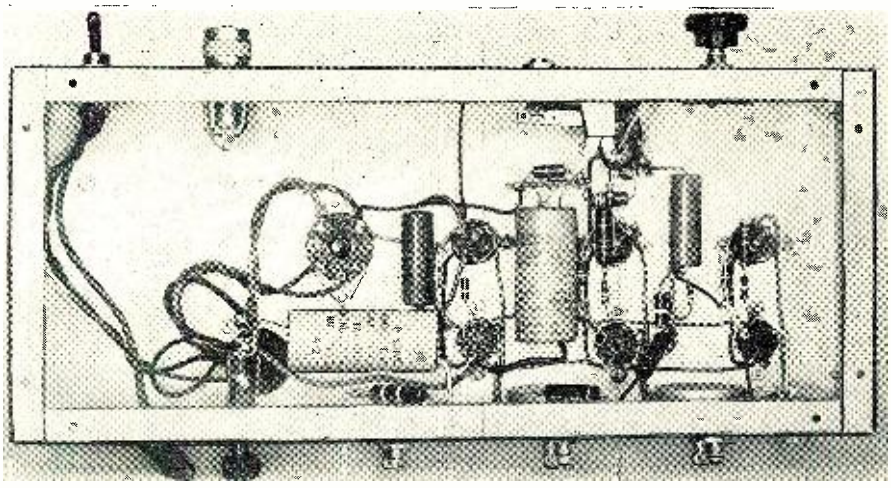
Build this different type of color organ with its long bar of multicolored, dancing lights.

IT'S GOT rhythm, drama, comedy, entertainment, and important educational potentials. This electronic device, called "Photorhythmicon" until some better and all-encompassing name is suggested, can be exactly what you make it: a gadget, a toy, a conversation piece, a spectacle, an adjunct to your high-fidelity system, or a working tool. It generates no noise of its own; does not reproduce music, speech, or any sound at all. What does it do? It gives off light. So does a table lamp? Yes, but this device gives off a bar-shaped light. So does a fluorescent tube? Yes, but this "bar" can be controlled to vary its brilliance, to glow with different colors and intensities. It appears to dance to and fro, following musical rhythms and variations in frequency and amplitude.

For example, connect the input terminals of the Photorhythmicon across the voice coil of your high-fidelity loudspeaker, put a symphony, mood-music, or jazz record on and watch the exciting display of "sound." The bass rhythm group will actuate the left third of the light bar, the melody will appear at the center, and the high-pitched instruments at the right third. An arpeggio will be especially effective as it appears to slide from one end of the "bar" to the other, while a full chord played fortissimo creates a spectacular display of colorful, brilliantly dancing lights.

A number of practical uses are suggested for the Photorhythmicon, in addition to its service as a visually delightful adjunct to a home high-fidelity system. For example, the lights create an interesting pattern when actuated by speech. Their reactions to different voice timbres are quite fascinating. The lights indicate the unusual amount of energy produced by some voices, especially those of experienced speakers, at the low and high ends of the audio spectrum covered by the light-control chassis. Visualize, if you will, an application in the production of theater and TV musicals. There is no electrical limit to the number of bulbs which can be actuated, no limit to the linear measure of the "light-bar." This makes it quite practicable to run the lights the entire length, width, or height of a large stage. In the case of a musical, the lights could be connected to the output of the audio channel driven by the orchestra microphone. Then, as the group or "chorus" dances about the stage, the off-stage or off-camera orchestra causes the lights to "dance" in rhythm or syncopation with the orchestra and cast; an exciting combination of sight and sound. There are values in applications in musical education with the use of this device as a visual metronome actuated by a microphone or other pickup connected to the instructor's musical instrument. Perhaps, in a like manner, it can be applied to the education of the deaf or near-deaf, helping them to "hear" music, speech, and other sounds by enabling them to see the vibrations.

Bottom view of the unique color organ is shown. Note the uncluttered appearance.



The Photorhythmicon consists of two separately assembled parts, one a bank of lamps mounted on a long rod, the other a chassis containing the control circuitry. The light-bar in the

unit illustrated contains 45 pilot lamps mounted side-by-side. They are series wired in three groups, 15 lamps per group. A yardstick purchased at a local hardware store for half-a-dollar serves as the mounting board for the 45 light sockets. A 4-wire extension cable connects the light bar to the control chassis.

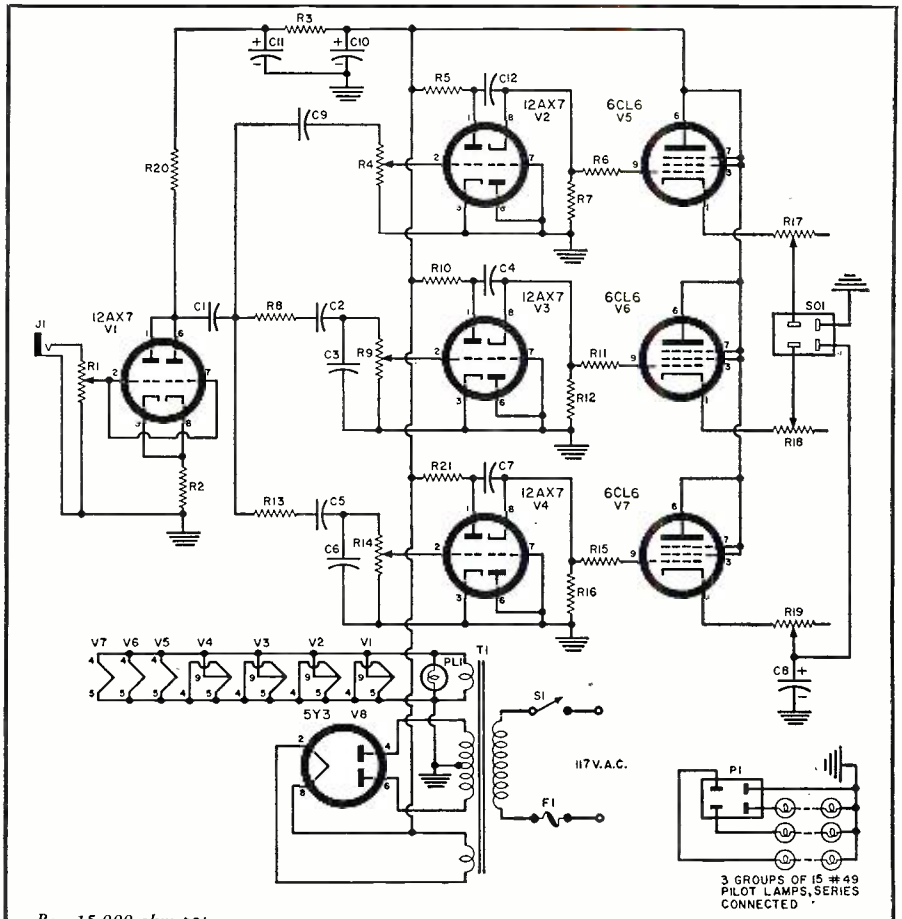
Each group of pilot lights is connected as part of the cathode circuit of a control tube featuring a high transconductance characteristic, that is, a tube which exhibits a relatively large change in plate current for a small change in grid voltage. Type 6CL6 tubes were chosen as the light-control tubes. Although triode operation of the 6CL6's does not take full advantage of their 11,000 micromho transconductance value, it does enable circuit simplicity and provides more than adequate performance in this particular service.

Rheostats are added at the chassis and connected in series with the lamps and the cathodes of the 6CL6's. These afford a convenient means for the adjustment of the resting plate currents of the 6CL6's to the desired point of darkness at the light-bar. This is, of course, very simply an application of cathode bias. We know, too, from vacuum-tube theory that if we alter this bias the resting current will also change. This can be done, and is done in this particular device, by applying a positive voltage to the control grids of the 6CL6's. As we decrease the bias, by increasing the positive grid-voltage, the cathode currents of the 6CL6 light-control tubes rise. Because the strings of pilot lights are in series with the cathodes of the light-control tubes, the currents passing through the lights likewise increase and the bulbs begin to glow. If we vary this grid voltage at an audio rate, the currents through the light-control tubes vary similarly and the strings of pilot lights change brilliance at comparably varying rates. Within controllable limits, the lights can be made to vary from just about full brilliance to total blackout.

It was found through experimentation that the #49 lamps were well suited to this application. Unlike other incandescent lamps such as floods, household lights, and other types of pilot bulbs, the #49 rapidly heats to the glowing point and just as quickly extinguishes when the heating current is diminished or is cut off. The #49 lamp is the so-called 60-milliampere bulb often used in flashlight service. I don't know how many foot-candles a flashlight is capable of producing, but 45 flashlights all glowing at the same time, it is my impression, should be capable of producing considerable illumination.

The amount of light produced by the Photorhythmicon is sufficiently brilliant to allow the operation of the device to be exhibited in full sunlight. Needless to say, therefore, it provides

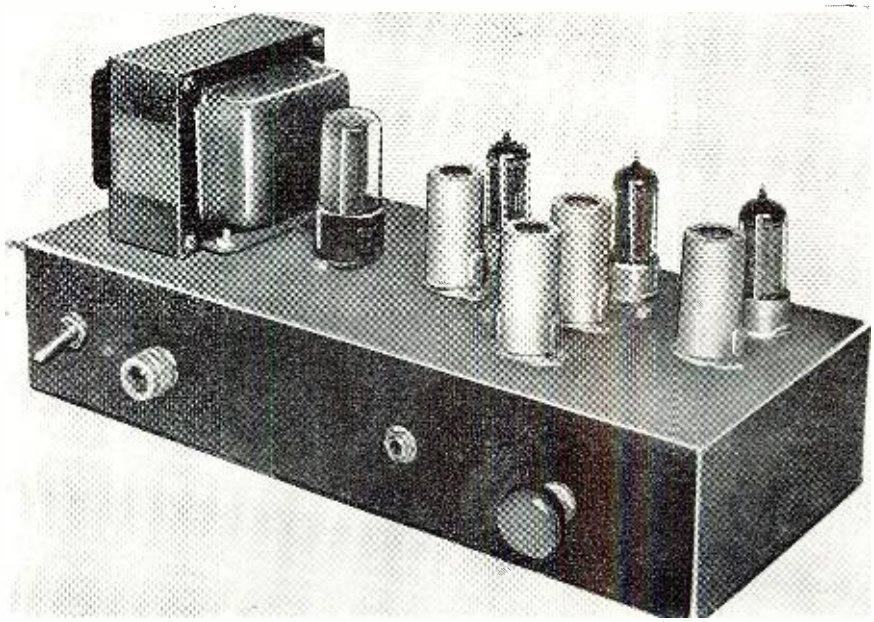
(*Continued on page* 92)



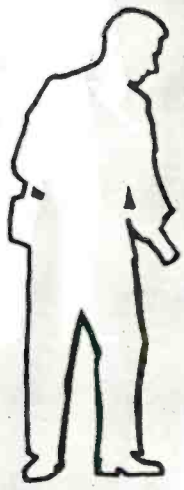
R1—15,000 ohm pot
R2—330 ohm, ½ w. res.
R3—5600 ohm. 1 w. res.
R4, R9, R15—500,000 ohm pot
R5, R10, R21—220,000 ohm, ½ w. res.
R6, R8, R11, R13, R15, R20—100,000 ohm, ½ w. res.
R7, R12, R16—470,000 ohm, ½ w. res.
R17, R18, R19—500 ohm, 4 w. wirewound pot
C1, C5, C7—.1 μfd., 600 v. paper capacitor
C2, C3, C4—.002 μfd., 600 v. paper capacitor
C6—.05 μfd., 600 v. paper capacitor
C8—40 μfd., 450 v. elec. capacitor
C9, C12—.00025 μfd., 500 v. ceramic capacitor
C10, C11—10 μfd., 450 v. elec. capacitor
J1—Phone jack
SO1—4-prong receptacle for light bar
P1—4-prong plug for light bar
S1—S.p.s.t. toggle switch
PL1—6.3 volt pilot light
F1—2 amp fuse
T1—Power trans. 325-0-325 v. @ 150 ma.; 5 v. @ 3 amps; 6.3 v. @ 5 amps (Thordarson 22R06 or equiv.)
V1, V2, V3, V4—12AX7 tube
V5, V6, V7—6CL6 tube
V8—5Y3GT tube

Fig. 1. Complete schematic diagram and parts listing for the Photorhythmicon.

Front panel mounts power switch, pilot lamp, input jack, and master gain. The six other adjustments, fuse, and output receptacle are all mounted on rear panel.



RADIATION DETECTORS – A Technician's View



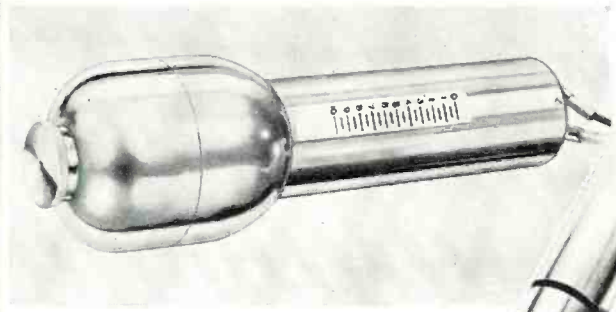


Fig. 11. Technical Associates SD-1.

Fig. 12. Technical Associates RS-11.

Part 2. Basis for operation of scintillation detectors and two models using this technique.

By **ALLAN LYTEL**
Electronics Laboratory
General Electric Co.

RADIATION from radioactive materials can be converted into visible light by the use of the fluorescent effect of certain substances. Among these substances are zinc sulphide and calcium tungstate. When a particle of radiation strikes a transparent crystal phosphor made of one of these materials, a flash of light—a scintillation—is produced. While these scintillations may be used directly, they are usually too faint and must therefore be amplified.

Scintillation detectors may be used to record *alpha, beta,* or *gamma* radiations, depending on the type of materials used. These counters are more sensitive than Geiger counters and they can also detect particles which are close together. It is possible, by the use of counters, to record in an accurate manner a large number of pulses in a very short time. In this way, the scintillation detector is sensitive to both the rate (frequency per unit of time) and the strength of the radiation.

Because the phosphor screen converts the radiation into visible light, a type of amplifier different from an ordinary vacuum tube is required.

Fig. 13 illustrates the operation of the special multiplier phototube used in this application. This sketch has been simplified for discussion; an actual tube diagram (a *DuMont* K1382) is given in Fig. 15. Radiation falls on the transparent crystal phosphor, where it creates scintillations of visible light. This small signal must be converted into an electrical signal and then amplified.

Any photocell sensitive to visible light can be used to convert light to a flow of current. Light striking the photo-cathode causes the emission of electrons. In the diagram, the photo-cathode is transparent. The light falls upon the transparent photosensitive cathode and causes electrons to be emitted. This weak signal is then amplified by electron multiplication. A series of small anodes (plates) or dynodes, are connected so that each has a higher electrical potential than the preceding one. (The one with the lowest potential is to the right in Fig. 13.)

Electrons are attracted to the first small anode or dynode nearest the photo-cathode. When electrons strike the first dynode, there is secondary emission (or the release of more electrons) caused by the original electrons striking this anode. In a vacuum tube, this is usually undesirable and the suppressor grid is used to dispose of these secondary electrons. However, in this multiplier tube, the secondary electrons are put to work.

Passing from dynode to dynode, the signal is multiplied each time by further secondary emission until it reaches the collector plate (anode). Gains between 250,000 and 1,000,000 times are possible, depending on the type of tube and the operating potentials.

Once the signal is taken from the collector plate it may be amplified by normal vacuum-tube circuits before it is applied to the output device. Fig. 15 is the circuit for the *DuMont* K1382 multiplier phototube with 10 dynodes.

Technical Associates SD-1

This scintillation detector, shown in Figs. 11 and 14, consists of a sodium iodide crystal, a photomultiplier tube, and a preamplifier. It is used for the detection of *gamma* rays, as noted, or it may be fitted with other crystals to detect *alpha* and *beta* rays. This detector is designed to be used with an external counter device.

Technical Associates FS-11

A photograph of this scintillation counter is shown in Fig. 12 and the schematic in Fig. 16. There are 5 sensitivity ranges of .01, .1, .25, 1, and 2.5 mR/hr and a 3-position time-constant control to adjust meter response. It uses a 1" by 1" sodium-iodide crystal and a photomultiplier tube.

In addition to the units described here, there are of course many other specific detectors and counters. However many of these are laboratory instruments with which the service technician is not likely to have much experience. The specific instruments described will account for a large number of those that he is likely to encounter. Others of the portable, relatively inexpensive units he may come across will certainly resemble one or another of the units discussed closely enough to permit comparison.

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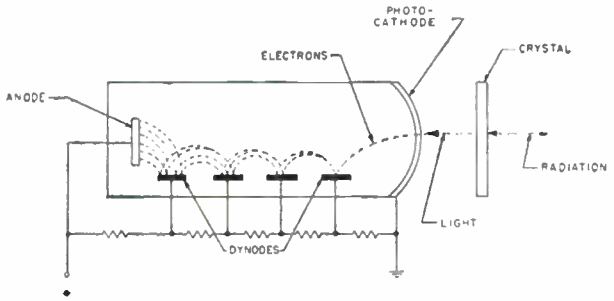


Fig. 13. Basic structure of the photomultiplier tube, showing how electron multiplication is used to deliver measurable output when the device is excited by few particles.

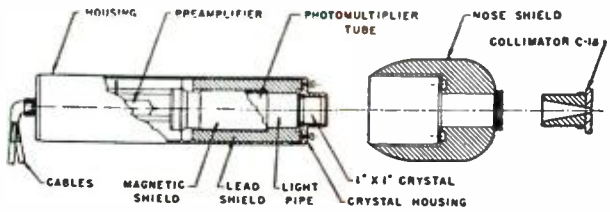


Fig. 14. Construction of the Technical Associates SD-1 Scintillation Detector, also shown in Fig. 11. Radiation excites a sodium iodide crystal. A photomultiplier tube and preamplifier tube are built in.

Fig. 15. Actual circuit using the DuMont K1382 photomultiplier tube. Radiation particles strike a crystal phosphor, where they create scintillations of visible light. The light is converted to an electrical signal, which undergoes amplification.

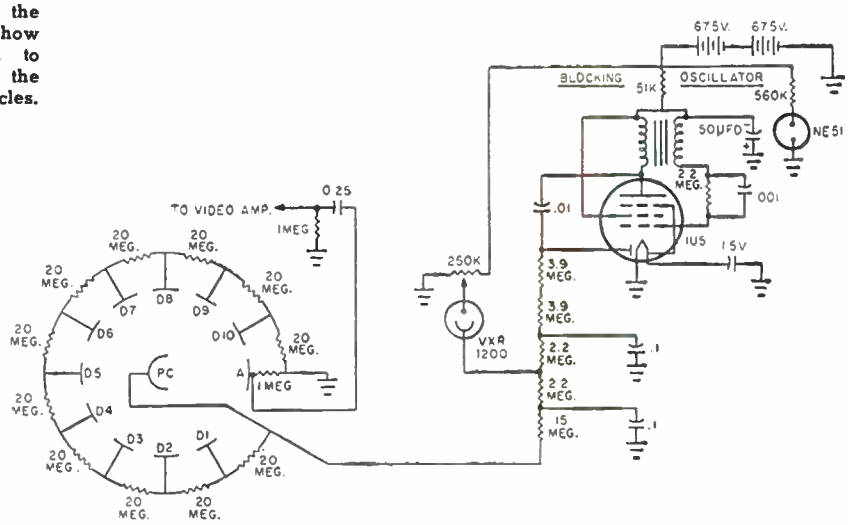
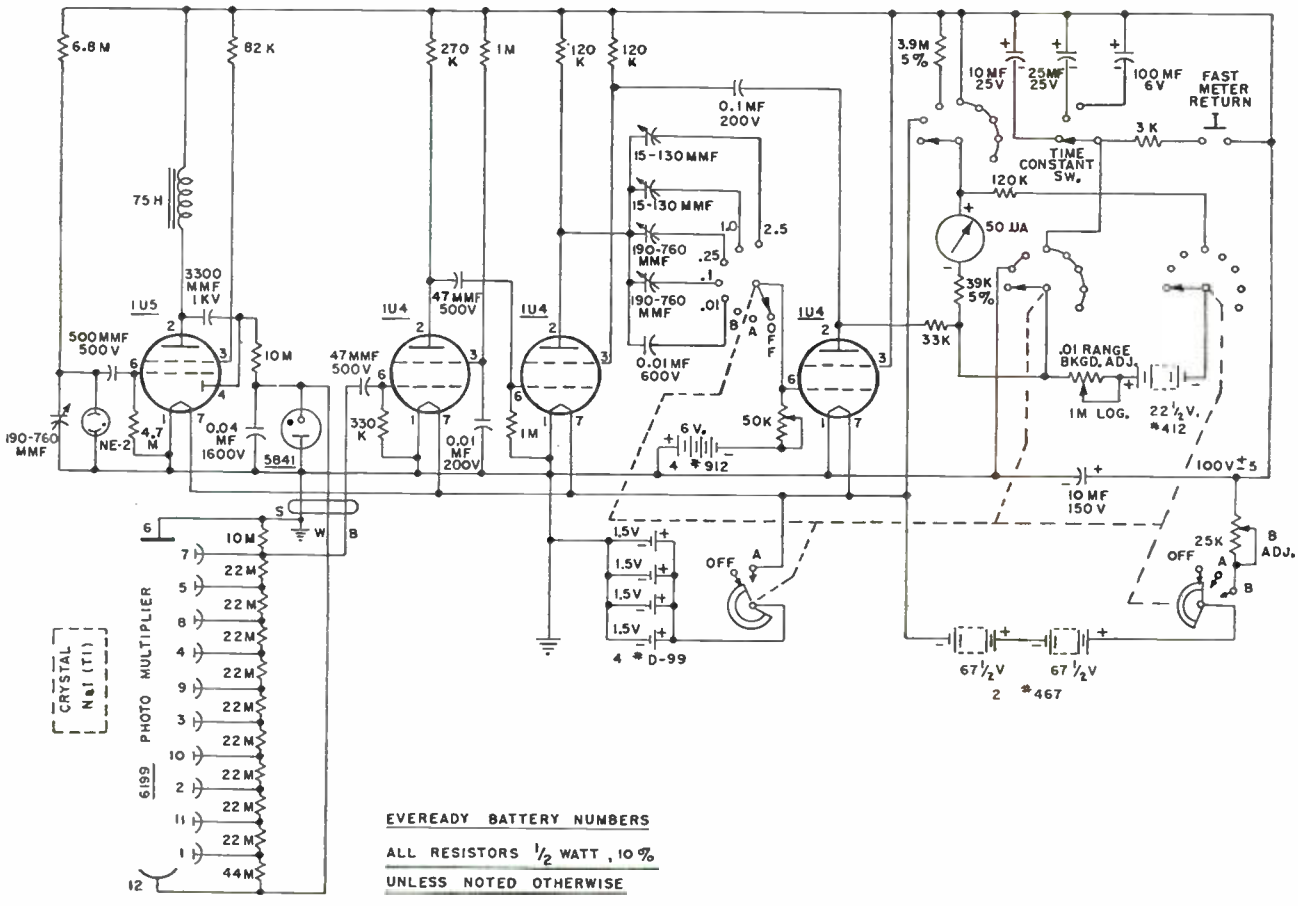


Fig. 16. Schematic for the Technical Associates Model FS-11 Scintillation Counter.



By **WILLIAM LEONARD**

Are your woes really caused by competitors? Your own merchandising methods may need re-evaluation.

THE most serious obstacle the technically trained and oriented man has to hurdle in his role as an independent businessman is to comprehend those negative factors in the building of a business that are commonly lumped together as "competition." A common complaint among dealers is that they cannot raise their service charges to equitable levels because their "competitors would murder them." But on close examination, this malevolent competition is usually a phantom force without form or substance, except in the dealer's mind.

In a recent editorial in the *"Hoosier Test Probe,"* Editor Robert M. Sickels realistically touched on some of the factors involved in running a service business in our free economy. Mr. Sickels said:

"Disgusted with predatory competition? Tired of trying to get a profit on quality products and service against price competition from insurgents?

"Let's be realistic. There are some things even a perfect trade association can *not* do for you. No association or individual can protect you in the market place. No law is going to eliminate competition for you.

"You fought to be born . . . and fight you must as long as you live. When a businessman comes to the full realization of this, he begins to learn how to fight more intelligently. He stops simply *doing* business, drifting from day to day, and starts *waging* business as a war.

"Cleanliness, common courtesy, punctuality, and sober judgement are as much at a premium among businessmen as in any army. An intelligent businessman learns how to outflank his competitor by outselling and outpromoting him."

All too often, businessmen in all lines are prone to place the blame for their business troubles on that phantom enemy they call "competition" when, in fact, these troubles are due to their own lack of business acumen or failure to use it diligently. This is especially true in any type of service business because of those intangible factors involving the quality of the work and customer relations.

Speaking on the subject of competition in the current economic situation, Harry B. Price, Jr., chairman of the executive committee of NARDA, recently posed a series of pertinent questions to his audience of dealers at a meeting in Baltimore, Maryland. Mr. Price asked the dealers:

"1. Do you know who your customers are and do you attempt to ascertain this information? 2. Have you ever asked yourself why a customer buys from you? 3. How much of the business in your area are you getting? 4. Who is your main competitor?"

In applying these questions to almost any electronic service business it is surprising, for instance, how few dealers know the pattern of customers they have developed for their businesses. It is equally surprising to learn how few dealers try to find out why customers have drifted away from them. Practically every dealer has a file of customers whose sets he has serviced. Yet very few ever bother to check up on themselves by contacting former customers to learn why they drifted away.

Most small service businesses were initially built on word-of-mouth advertising. The enthusiasm of a new dealer for his business is usually infectious. Customers sense this spirit of enthusiasm and it inspires them to recommend the technician to friends who are in need of TV service. This generation of business through customer referrals continues as long as the dealer is able to maintain his first enthusiasm for the business.

Time and the constant grind of meeting technical and business operating problems take their toll of the technician's enthusiasm. Soon the business settles down to be a job. The dealer depends on his phone book and other advertising for his service calls rather than on the recommendations of his customers. It is during this period that the average service business starts to drift with the tide of seasonal fluctuations. It is the time, too, when some solid, concrete information about the local market for service would be mighty valuable.

The electronic service business is perhaps the only industry that constantly has a virtual one-hundred percent consumer market for its services. Among the wide variety of electronic products that are used in every home, there is always at least one that needs service. Competition is keen for the easy part of this business, that part where a set owner looks for a technician to fix his set. But there is practically no active competition for the biggest part of this consumer business. That is the "I'll-have-it-fixed-someday" part where customers put off buying the service they know they need.

To be continuously successful, a businessman must know his local market and the type of people who make up that market. He should develop information on the dollar volume of

(*Continued on page* 87)

A Color Case History: 3.58-Mc. Oscillator Failure

A specific, informative instance of trouble in an area where practical experience is still short.

By **WARREN J. SMITH**

DEFECTS in the color-sync circuits of color TV receivers are not at all unusual. Quick repairs are just as common. However, even a simple misadjustment or lack of re-adjustment, such as the one which will occur occasionally in one of the newer color circuits, could prove to be a tricky service problem if the technician isn't on his toes.

Take the recent service headache experienced by Harry Gridleak as an example. For Harry, it all started as a routine color service call. The customer's complaint sounded routine too: black-and-white reception was fine but the color had suddenly quit entirely. Harry logically reasoned that the symptom indicated a breakdown somewhere in the color-sync circuits, since this section is required only for color operation. It recreates a 3.58-mc. subcarrier signal of the same frequency and phase as the subcarrier signal that is originally used at the transmitter. The locally generated subcarrier, provided by the 3.58-mc. oscillator, is re-inserted in the received chrominance sideband signals to replace the original subcarrier which is suppressed before transmission. This re-insertion of course is a necessary step for color demodulation.

Harry began checking the tubes in the color-sync section of the receiver on his emission checker. As he had anticipated, the 3.58-mc. oscillator tube, a 6CB6, tested weak. "Too weak to oscillate in the circuit," he murmured almost out loud to himself. Feeling somewhat relieved at the thought of a simple tube replacement, Harry inserted a new 6CB6, turned on the power, and then stood back to await the results. To his surprise nothing happened; the replacement tube failed to clear up the difficulty.

EDITOR'S NOTE: *Nothing will do more to take the mystery out of color TV than actual experience. Here is a case history in which a technician ran into a defect related to a circuit that does not have its counterpart in a monochrome receiver. True, it was something of a tough dog, but something like it could have happened with a black-and-white set. The pattern of being led astray by a misleading symptom and of finally seeing the light is familiar to every experienced technician, whether he has worked on color receivers or not. We are sure that, after his success, Harry Gridleak must have felt at least a little like saying, "Color service? There's nothing to it!"*

Being cautious, he tried the only 6CB6 remaining in his tube caddy. Like the first one, it failed to remedy the situation.

As most readers have probably noticed, when a tube like the 6CB6 is conducting a reasonably high current, as in an oscillator circuit, a faint blue haze generally appears just inside the tube envelope. Harry made a close inspection of the second 6CB6 for signs of this tell-tale haze. Instead he saw a subdued cherry-red glow on the plate, a sign that the tube was conducting a little too heavily. Now feeling fairly certain that a defect had developed in an under-the-chassis component, Harry loaded the set in his station wagon and headed for the shop.

Back at the shop, Harry was somewhat chagrined to find that the set was a late model and that he didn't have a schematic or service literature covering it. He telephoned the customer, the local distributor of the receiver, and a couple of friendly competitors in an attempt to obtain the necessary service data, but the calls failed to turn up a single usable scrap of information. Harry decided that under the circumstances his best bet was to attempt a repair by searching for some obvious defect in the 3.58-mc. oscillator. But as far as he could determine from his checks, everything in the circuit was OK. Harry was now beginning to feel those familiar pangs of desperation.

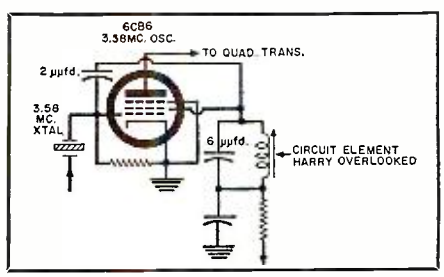
Realizing that his chances of repairing the receiver were now very remote without a schematic, Harry shelved the set and wired the manufacturer for the necessary data. It arrived two days later.

A rapid point-to-point resistance test of the oscillator revealed nothing; all meter readings were well within tolerance. Harry checked the oscillator tube again for the overheated plate. Sure enough, it still glowed with that subdued cherry-red color. Following up with a quick voltage check, Harry uncovered the clue he was searching for: the negative grid voltage was much too low.

Certain that he was now on the right track, Harry substituted a new 3.58-mc. crystal (see Fig. 1)—and then new tubes in the stages ahead of the oscillator when the new crystal failed to cure the trouble. All the substitutions were to no avail, for the grid voltage still remained too low and apparently unaffected by the new com-

(*Continued on page* 93)

Fig. 1. The subcarrier oscillator responsible for our hero's nightmare.



Make More $ $ On TV Antenna Replacements

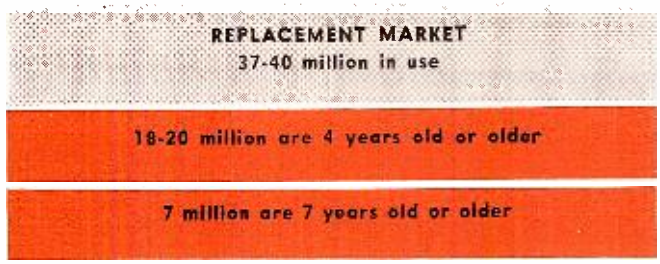
As new set sales drop off, owners are more concerned than ever with getting the most out of old sets. The time is ripe for a national sales push in replacement antennas. Get your share!

ARE YOU A SERVICE DEALER looking for new ways to improve business? Some of the statistics on this page concerning TV antennas should be of interest to you. A dip in the antenna business last year as compared to 1956 would seem to indicate a downward trend. However, a closer examination of the market shows that other, more encouraging factors must also be considered.

In the first place, there is a definite downturn in the rate at which people are buying new TV receivers. Superficially, it would seem that antenna sales should follow in line. However, the tail-off in new set sales also means that viewers are keeping their old sets and that they are more willing than ever to invest in getting the most out of them before they spend the greater sums required for receiver replacement. Getting the most out of an old set often means getting a new antenna, although many viewers need to be made aware of this fact.

In the second place, other figures on this page show that, of the antennas in use, a staggering number have either become practically useless or are contributing very little to receiver performance. Seven years of use is considered to mark the virtual end of life for an antenna system. In fact, after four years, most systems are no longer efficient.

Based on these facts, a major antenna-replacement campaign, directed primarily at the consumer level, gets under way next month. Manufacturers, distributors, and sales representatives throughout the nation are co-ordinating their individual campaigns to develop consumer awareness of certain important facts. Among them are these:



1. As already noted, antennas do not last forever. Furthermore, their decline is so gradual that the set owner seldom understands why, after a certain number of years, his *set* "just doesn't seem to have the pep it used to."

2. Physical damage, corrosion, and deterioration of lead-in systems are some of the chief factors contributing to the loss of efficiency in the system. Antennas should be inspected periodically to make sure that they are performing their job properly.

3. Many antennas, originally installed along with one particular receiver, are still in use although the receiver may have been changed, or one or more new ones may have been added, or an FM tuner is also being operated from the same antenna. These later changes may have considerable effect on suitability of the initial antenna system.

4. Antennas installed prior to the introduction of all TV stations available in a given area or before old stations revised their transmission patterns, may no longer be as satisfactory as they were for the earlier conditions.

5. Over the years, manufacturers have developed many new designs with improved technical performance features. They have also learned much about the use of better materials and improved physical design. Many newer antennas can do jobs that were beyond the range of older types.

All of these important facts, as well as others, will be accented to a vast consumer audience during the next few months. Leading antenna manufacturers are participating in the co-ordinated, nationwide campaign sponsored by RADIO & TV NEWS and other *Ziff-Davis Electronic Division* publications. For additional details on this program, see the 10-point program featured with this story.

The point of the entire program is to stimulate sales for service dealers. The key to success of this program to replace millions of antennas in American homes will be the co-operation and active participation of the service dealer

in developing sales. We quote one manufacturer who has been working carefully on plans for this promotion for some time and has a complete program ready to go:

"Our success is entirely dependent on our dealer acceptance and active participation. Market research has definitely established the potential for replacement sales. Our problem is to convince the dealers to push antennas to people who *don't know they need a new one.*" The italics are ours.

More than 80 per-cent of the antennas sold in this country are purchased from service dealers and parts jobbers. This means that more than $40 million in potential sales may be at stake during 1958!

"To assure yourself of a share of the antenna volume," says another manufacturer, "plan your program *now* to tie in with the merchandising effort being made by the entire industry."

Today, manufacturers are busy holding sales meetings, passing out new material to sales representatives, and arranging sales tours. Soon radio parts jobbers and distributors will have details and material ready for distribution to their service-dealer accounts.

Point-of-sale material, direct-mail pieces, newspaper mats, and prepared radio spots will undoubtedly represent a major portion of the local advertising expenditures. Co-op advertising budgets, with dealer-listing ads as a predominant item, will be bigger than ever.

States still another antenna manufacturer: "We look for a continuation of the constantly expanding replacement antenna market during the year 1958. More TV sets are in use today than ever before. Many homes now have two and as many as three receivers installed and in use each day."

It is true that Americans have become more conservative recently as far as spending money for outside leisure activities is concerned. However, this means that more people will be staying at home—watching more TV than ever before. With the market thus ripe for new antennas and with manufacturers and distributors geared up to promote sales nationally, the success of the program rests with you —the service dealer. The 10-point program can be your start.

Examining the prospective customer for 1958, experts tell us that he is no longer interested in sub-standard merchandise. Professor Lahti of the University of Michigan's College of Architecture and Design believes that, for the first time in history, we are living in an era marked by taste on a mass basis. People are now inclined to buy quality. The customer is purchasing merchandise in a more discriminating manner—and learning that he must pay for quality. He is also coming to feel that, in the long run, this is the economical way.

This changing attitude is good news to the antenna industry, which has seen prices kicked around for the past few years to the point where its merchandise has become minimum-profit stock in some places. But it will only be good news if dealers and their salesmen sell features instead of price. Selling a better antenna not only means a longer profit, but also greater customer satisfaction.

Some final words: key to the entire plan is YOU, the dealer. Manufacturers and jobbers are geared to do their part. Unless you contact the customers and make the sales, the effort will be wasted. —30—

COMING NEXT MONTH

Choosing The *Right* Antenna

THOUSANDS of reception problems that have been blamed on the receiver or on local conditions can be solved with the RIGHT antenna system. Deteriorated or outmoded antennas, or those that were never designed for the type of reception you need, rob your set of picture power, deprive you of viewing pleasure. Before you try a new set—try the right antenna. Don't miss our September issue. It will help both you and your customers solve the problem.

10-POINT PROGRAM TO INCREASE SALES

1 CHECK YOUR ANTENNA STOCK. Make sure it is complete. Know the requirements of your area. Have an adequate assortment of antenna types on hand to take care of the demands for any possible reception situation.

2 GET HELP FROM LOCAL BROADCASTERS. Local TV broadcasters, along with their AM and FM affiliates, will be only too glad to help promote better receiving antennas in their areas, since it gives them wider coverage with improved quality. Spot announcements should not be difficult to arrange, especially where a group rather than an individual makes the approach. Work through your local service association, your jobber, or your factory representative. If preparing the copy for these spots is a problem, write to us for prepared copy.

3 SET UP A DISPLAY. This is a "must" when you are featuring a product. A floor display is fine; windows are ideal. Promotion kits, including window banners, posters, descriptive material, consumer hand-outs, instructions on how to do a bang-up job of promoting antenna sales, give-away items, and other material are available from parts jobbers everywhere. For leading antenna manufacturers participating in the special fall promotion being sponsored on a nation-wide basis by RADIO & TV NEWS and other *Ziff-Davis Electronic Division* publications, these kits will be in jobbers' hands about August 26.

4 DEVELOP YOUR INDIVIDUAL CAMPAIGN. To make certain that your fair share of the anticipated sales potential is attracted to your own shop, work up your own special-inducement program. A free home inspection of the prospective customer's antenna system, with an appraisal of how it can be improved, is one sure way of calling that customer's attention to the importance of this vital link in the enjoyment of good TV reception.

5 CARRY ANTENNAS IN YOUR SERVICE TRUCK. A few of the type most generally used in your service area, together with installation accessories, should go with you on all outside calls. There is a good potential in on-the-spot sales. Every service call your shop makes provides an opportunity for pushing the benefits of a new antenna system. A quick check of the customer's antenna before you enter his home is a good starting point.

6 ORGANIZE A DIRECT-MAIL CAMPAIGN. If you don't have a mailing list of your own covering actual and potential customers in your service area, use a reverse telephone directory. (Such a source carries listings by street address or location, rather than alphabetically.) You can send a post card to every prospect on the list, telling him that your antenna specialist will be in his neighborhood on a specific date at an approximate time for the purpose of giving his antenna system a free inspection. Ask the prospect to call or return a self-addressed postage-free card for a free inspection.

7 WORK WITH YOUR SUPPLIER. Tie in with his local advertising campaign. Be sure your store is listed in all co-operative newspaper ads and in any co-op radio spots being used to promote a line you handle. Investigate the possibility of advertising allowances. Check your supplier for sales leads—and follow up those you get.

8 KNOW YOUR ANTENNA LINE. Hold a sales meeting with your jobber salesman or factory representative to get the complete details on the line you handle. Remember—you must be certain that you are ready with information, merchandise, and installation service BEFORE you make contact with the customer. This will win his confidence. It will make it easier for him to buy.

9 MAKE A SURVEY in your area of home owners and apartment dwellers by telephone or personal call. You can use high-school students or sales trainees to determine who is interested in discussing TV reception problems.

10 PLAN YOUR SALES CAMPAIGN. Write it down in advance. Don't fumble along as you go. After you have done this, FOLLOW YOUR PLAN.

By **JOHN T. FRYE**

LITTLE THINGS

BARNEY came hustling into the service department after his lunch hour to find Mac, his employer, looking over several small articles spread out on the bench before him.

"Whew! It sure is a sizzler out there today," Barney exclaimed as he mopped his neck with his handkerchief. "I even skipped my dessert so I could hurry back to this air conditioning. What you got there?"

"Dick, the parts salesman, was here while you were gone and he did a real cute little job of selling on me."

"Howszat?"

"Well, as you know, things have been moving pretty slowly in his business for quite a spell; but Dick's not the sort just to sit around and bellyache about this. He says he has enjoyed every wonderful minute of the past few years when all he had to do was be an order taker; but now if he's got to buckle down and do some hard selling, he's ready and willing to do it. What's more, he demonstrated to me today that he wasn't just talking."

"Well, come on, come on!" Barney said impatiently; "let's not make a full-length mystery out of this. What did he do?"

"After I had given him our regular order, he said he wanted to bring in something from the truck to show me. That 'something' was a good-sized, neatly arranged box of small items that he thought would be of interest to service technicians if they just had a chance to see and examine them.

"Dick explained that when most fellows came into the store they had some specific items in mind and they were in a hurry to get these and get out. They never had time to browse around among the countless little gadgets and timesavers the store stocked. His bright idea was to bring a collection of these items right to the shop where the technician could look them over at his leisure."

"By the looks of the things there on the bench, Dick's idea must have paid off here; and if he can wring money out of a Scotsman like you, he can sell anybody."

A slow grin spread across Mac's face as he replied, "Almost Dick's exact words! But let's talk about some of these things before I put them away. Take this probe, for instance. We could have used it a hundred times. Notice the probe tip itself is a full four inches long and only $\frac{3}{32}$" in diameter. This tip is insulated for its full length except for an exposed $\frac{3}{16}$" at the very tip. That thin probe can be worked down into places a conventional probe could never go. What's more, you can use it without fear of shorting something out, as you do so often with a naked probe tip. It will be ideal for working on those crowded transistor sets. A slip of the probe in one of these can blow a bunch of expensive transistors faster than you can say, 'Wups!'"

"Hey! Here's something real cute," Barney said as he picked up some miniature microphone connectors. "They look just like the regular ones except they are only about one-fourth as large. With the modern trend toward making things smaller and more compact, I'll bet we are going to see more of these."

"I agree, and here are some miniature phone plugs and phone jacks to match. About the only place I have seen these used so far are in transistor receivers for connecting the earphones to them; but there is no good reason I can see why they should not be used other places to save space."

"What are those little red and black cylinders?" Barney asked.

"Those are banana-plug connectors. As you know, we have a lot of test leads made up with a banana plug on one end and an alligator clip on the other. Every now and then a set of these leads are a little too short to reach where we want to go. When that happens, we cobble up some makeshift connection that is always shorting to the other lead or falling apart. Now, when we need longer leads, all we have to do is to plug the banana plugs into the ends of these insulated, color-coded connectors; and we'll end up with a set of nice long leads with convenient alligator clips on both ends. They are just another little item that can save a lot of time and exasperation."

"What's in the little plastic box?"

"That's a complete kit for replacing the selenium rectifier in an a.c.-d.c. receiver with a silicon rectifier. *Sarkes Tarzian,* who brought out the silicon rectifier specially designed for radio and TV servicing, is putting it out. As you can see, it consists of a type M-150 silicon rectifier and mounting clip. Hardware is furnished for mounting the clip to the chassis. A 10-ohm resistor that is to be connected between the 'B-plus' output of the rectifier and the first filter capacitor is included. This must be used because there is less voltage drop across a silicon rectifier—only 2 volts—than across a selenium unit and without this resistor the voltage furnished the tube filament string would be too high. Remember this 10-ohm resistor is to be *added* to the current-limiting resistor of 22 ohms or more already used with the selenium rectifier. Under no circumstances do you remove the resistor already in the set."

"Gotcha! I can see right now where this is going to come in handy. A lot of those a.c.-d.c. sets use special small selenium rectifiers that cannot be replaced with ordinary selenium units for lack of space. We've had sets held up several times in the past while we ordered an exact-duplicate rectifier. There will always be room for this little fellow in those receivers."

"That's right and if we run into a case where things are too crowded to mount even the little rectifier clip, we can leave it out and use these pigtailed caps that slide over the ends of the rectifier and make it a self-supporting unit that takes up practically no room at all. In general, let's continue replacing selenium rectifiers with other selenium units when this is easy to do; but don't forget our little friend here when a standard selenium rectifier won't fit."

"I'll bet we're going to see more and more of these silicon jobs in new equipment," Barney remarked. "In addition to other advantages, they throw off much less heat than comparable selenium rectifiers; and that's important in these compact three-way portables. On the other hand, of course, transistors are taking over in the portable field so fast that maybe the three-way portable will soon be as extinct as the coherer. The battery drain of the transistor jobs is so low there's no sense in using them on the a.c. line at all."

"Good! I like to see you trying to look ahead and guess what may happen in our field. You can't always be right, naturally, but it helps to glance up from your immediate work now and then and take a long look ahead. And speaking of work, we've got to get at it; but first let me show you one more item. Here is the *Sprague* 'Universal Ceramic Capacitor Kit CK-4' that Dick sold me. As you can see, it consists of twelve little flat units that look like

(*Continued on page* 107)

The Multi-Dipper

By **PAUL POPENOE, JR., W6IWM**

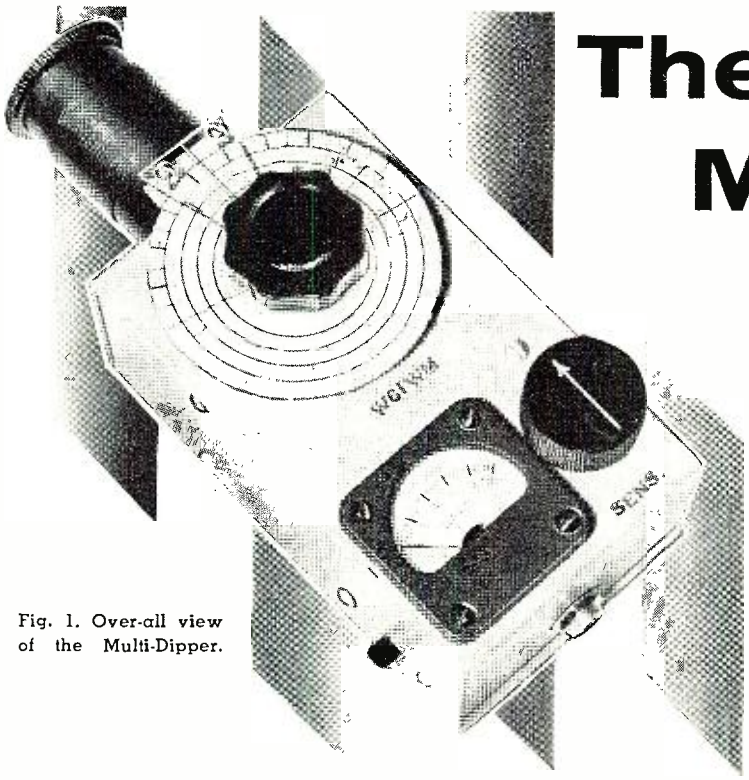
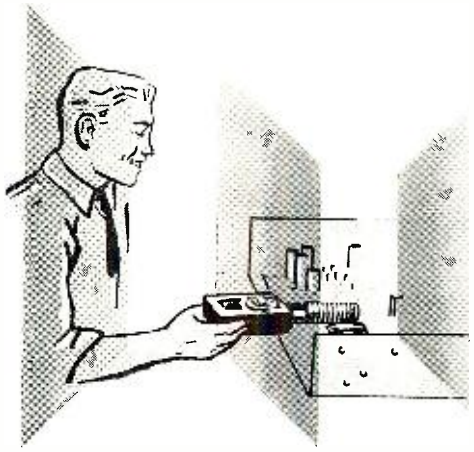


Fig. 1. Over-all view of the Multi-Dipper.



Ultra-versatile g.d.o. is also monitor, field strength meter, signal tracer or injector, and code oscillator.

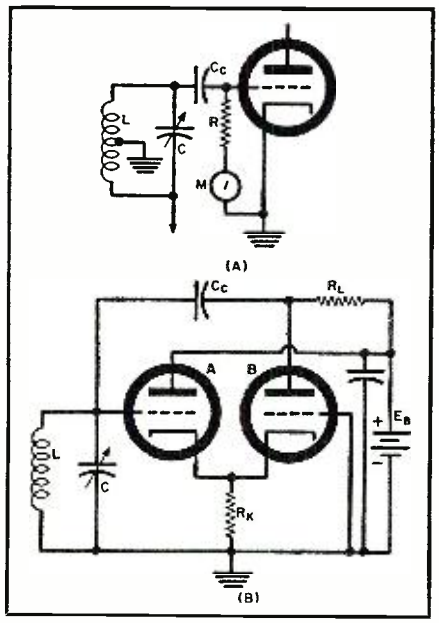
OVER the last several years the grid-dip meter has enjoyed increasing popularity among those in the electronics industry. Starting first with amateurs, the instrument found wide use in the ham shack. It made possible quick analysis of transmitter and receiver resonant frequencies, eliminated much cut and try operation in the building of new rigs, and proved a great help in the tuning up of antennas. Today, this versatile test instrument has been taken over by the radio service industry, where its time saving operations mean money in the pocket.

Strictly speaking, the device shown in Fig. 1 is not a grid-dip meter since the meter does not read grid current. However, it does perform in the same manner as a grid-dip meter and, in addition, has a number of other features which should prove extremely valuable around the ham shack. For instance, when no power is applied it becomes an ordinary crystal diode absorption wavemeter. It may be used as a phone monitor or field strength meter. With suitable attachments it becomes a neutralizing indicator, a signal tracer, a multivibrator-type signal injector, or a code oscillator.

Theory of Operation

Fig. 2A shows a portion of a typical grid-dip meter circuit. When conditions are correct in the rest of the circuit, oscillations will be set up between L and C. Assuming this condition, capacitor C_c will couple some of the energy out of the tank circuit to the grid of the tube. On positive peaks of oscillation the grid will be driven positive and will draw electrons from the cathode. This current will flow through the grid leak, R, and through the meter, thereby causing the meter to deflect. In other words, as far as the d.c. grid current is concerned, the tube is acting like a diode. The reading on the meter is directly proportional to the strength of the oscillations in the tank circuit. If for any reason some of the energy is drawn out of the tank circuit, a dip in grid current will be indicated on the meter. Coupling the tank circuit to another resonant circuit at the same frequency removes a great deal of energy from the oscillator. The grid-dip meter is, therefore, a very good indicator of resonant frequencies in passive tuned circuits.

Fig. 2. (A) Partial circuit and (B) basic two-terminal oscillator circuit. See text.



When a grid-dip meter is used as an absorption wavemeter, the cathode is kept heated, but the plate voltage it turned off. Under this condition oscillations cease and the grid circuit operates like a diode. If the tank circuit is now coupled to a source of radio-frequency energy and tuned to resonance with it, the diode current flowing through the meter will give an indication of the energy. One disadvantage of this arrangement is that it is necessary to keep the tube filament heated. Another more serious disadvantage is the insensitivity of the arrangement. Since the grid resistor must be of a fair size to develop bias, a considerable amount of power will be dissipated across it. For instance, if R = 20,000 ohms, and one milliampere of current is flowing, the power in the circuit will be $(.001)^2 \times 20{,}000 = 20$ milliwatts. On the other hand, if it were possible to eliminate R, the only resistance left in the circuit would be that of the diode and meter, say 200 ohms. Under that condition the power required to give full scale deflection on a 1 milliampere meter would be only $(.001)^2 \times 200 = .2$ milliwatt. That is only one hundredth as much power as required in the former case. A further disadvantage of the vacuum-tube diode is the presence of emission current, which, on weak signals, may be even greater

FREQ.	TURNS	WIRE	DIA.	LENGTH	TAP AT	WINDING
.36-.75 mc.	276¼	#34 en.	1½"	2"	107½	closewound
.75-1.5 mc.	142¼	#28 en.	1½"	2"	38½	closewound
1.4-3.2 mc.	74¼	#26 en.	1¼"	1¼"	18½	closewound
3-7 mc.	31¼	#20 en.	1¼"	1"	8½	closewound
6-13 mc.	12¼	#20 en.	1¼"	⅜"	3½	closewound
12-26 mc.	6¼	#20 en.	1¼"	9/16"	2½	
23-55 mc.	2¾	#20 en.	1¼"	½"	½	
40-95 mc.	1¾	#14 plastic*				

* ¾" dia., self-supporting, closewound, 1¾" leads from tip of plug pin to bottom of coil. Tap on lead at 1¾" from tip of ground pin on plug.

Table 1. Coil winding information for the construction of the coil L_1.

than the signal that's to be measured.

The Multi-Dipper has overcome these objections to the grid-dip meter by separating the functions of oscillator and diode indicator. In place of the grid circuit of a tube the Multi-Dipper uses a crystal diode in the indicator circuit. In order to prevent excessive loading of the tank circuit, the diode is tapped down on the coil to obtain a suitable impedance match. The oscillator used is a two-terminal, cathode-coupled oscillator. A two-terminal oscillator needs only to be connected across a parallel resonant circuit in order to set up oscillations. It requires no external feedback and, therefore, gives almost uniform output across the tuning range of the tank circuit. This is an advantage over the normal grid-dip oscillator which depends upon a Hartley or Colpitts feedback circuit and produces a level of oscillations dependent upon the amount of feedback. Since the amount of feedback varies with reactance and reactance varies with frequency, there is often a considerable variation in oscillator output across any band. This condition is undesirable as it sometimes requires frequent resetting of the sensitivity control. In addition, with the meter current varying it is more difficult to spot the dips that might occur.

Referring to Fig. 2B, consider that oscillations have been set up in the tank circuit *LC* and that at a given instant the potential at the grid of tube *A* is becoming more positive. An increase in the positive grid voltage will cause an increase in plate current. This, in turn, will cause an increased voltage drop across the cathode resistor, R_k. This means that the voltage on the cathodes of both tubes will become more positive. This is the same as making the grid of tube *B* more negative with respect to the cathode. An increase in the negative voltage on the grid will cause less plate current to flow and this, in turn, will mean less voltage drop across the load resistor, R_L, and a more positive voltage on the plate. If this positive change of voltage is applied through C_c to the grid of tube *A*, it can be seen that this feedback is in the proper phase to augment the original voltage on the grid and thus sustain the oscillations in the tuned circuit. Further analysis will show that if the tuned circuit is replaced by a resistor, the oscillator will operate as a free-running multivibrator.

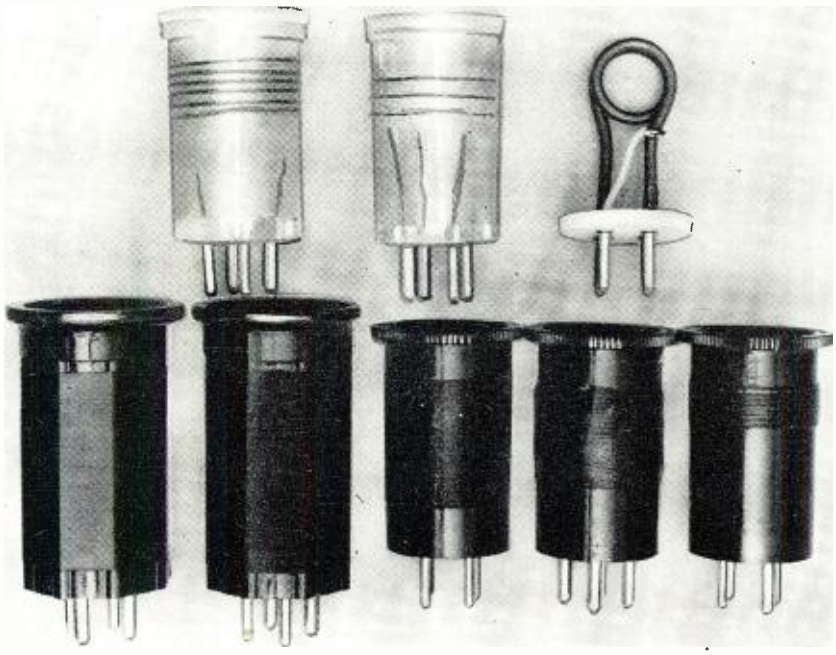
Circuit Features

The complete Multi-Dipper circuit, shown in Fig. 6, is composed of a two-terminal oscillator, a tuned circuit, a diode r.f. voltmeter circuit, and a power supply. The oscillator is built around a type 6BG7 or 6BF7W subminiature twin-triode, special-purpose tube made by *Sylvania*. These tubes are electrically identical, with the 6BF7W having flexible leads and the 6BG7 having a button base. A type 6J6 miniature tube may also be used in this circuit. The 6J6 is somewhat larger and requires 0.45 amp. heater current as compared with 0.3 amp. for the subminiature tubes. Other twin triodes such as the 6SN7, 12AT7, or 12AU7 are also suitable for use in this circuit but their larger size precludes miniaturized construction.

Since the cathode-coupled oscillator depends upon the building up of signal frequency voltage across the cathode resistor, capacitance between cathode and ground will have a deleterious effect upon the operation of the circuit, especially at very-high frequencies where the capacitive reactance is low. Such a capacitance is present between the heater and the cathode of the tube. As the frequency is increased, the oscillator output gradually drops off until a point is reached where oscillations cease. Three things may be done to decrease the effect of this bypassing action. First, the cathode resistor may be made small, so a given capacitive reactance will have less shunting effect than it would have on a large resistor. Secondly, a small inductance may be inserted in series with the cathode resistor to make the circuit broadly parallel-resonant at higher frequencies. The third alternative is to place small r.f. chokes in series with the heaters to raise them above ground potential for r.f. This last method is too frequency sensitive and not suitable for use in a wide-range oscillator. Using a small cathode resistor has the disadvantage of decreased output at all frequencies. 500 ohms for R_3 represents about the optimum value. The cathode-peaking-coil method of high-frequency compensation was found to be the best in this circuit. Since data on cathode-to-heater capacitances is not readily available, it is necessary to determine experimentally the proper value of peaking-coil inductance. This will vary with the type of tube used. For the 6BG7 or 6BF7W, L_2 consisting of 6 turns #20 enameled wire closewound on a 3/16-inch polystyrene rod was found to be suitable for operation up to 95 mc. A type 6J6 tube may require slightly higher inductance. For the 6J6, a coil consisting of 20 turns on a ¼-inch rod was found to be suitable for operation to 60 mc.

The tuned circuit consists of a 100 $\mu\mu$fd. variable capacitor, C_1, and a plug-in coil, L_1. The minimum circuit capacitance is rather high since the input capacitance of one triode is effectively in parallel with the output capacitance of the other triode. It is therefore necessary to have a fairly

Fig. 3. Coils for Multi-Dipper. They cover range of 360 kc. to 95 mc.



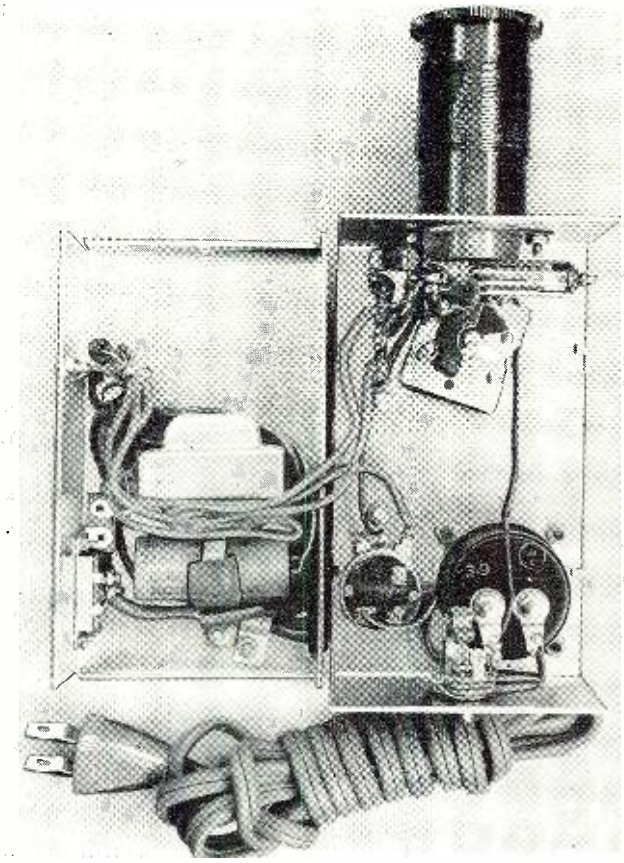


Fig. 4. Here is an inside view of the ultra-versatile Multi-Dipper that was constructed by the author. Power supply components are at the left, the oscillator itself is at right.

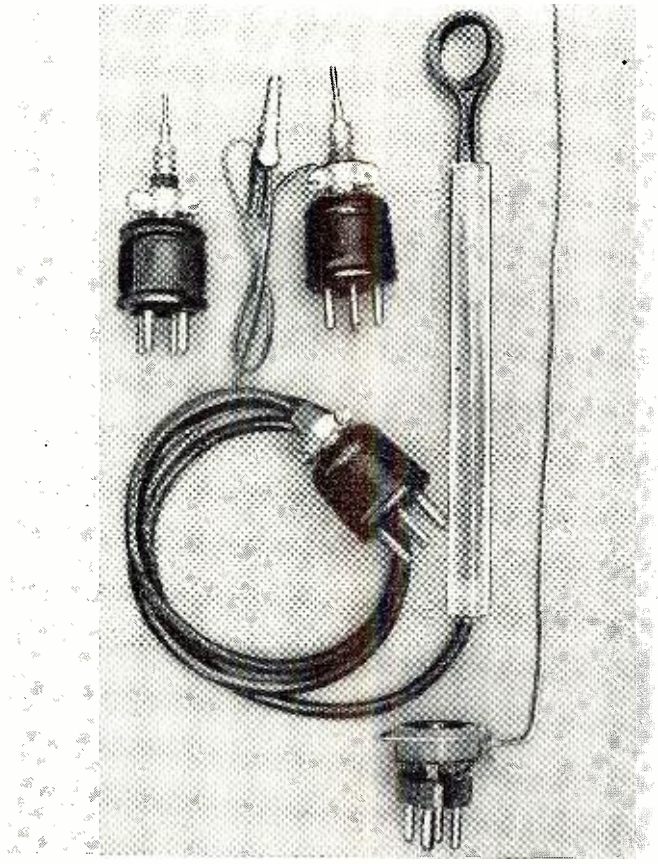


Fig. 5. Accessories for use with Multi-Dipper. From left to right are shown signal injector probe, signal tracer probe, the neutralizing probe, and the field strength meter adapter.

large value of C_1 in order to obtain a large ratio between maximum and minimum tuning capacities. A value of 100 $\mu\mu$fd. gives a frequency tuning ratio of slightly better than 2 to 1. The coils at L_1 are wound on forms that plug in to a standard 4-prong tube socket. The coil table (Table 1) gives winding data for coils covering the range 360 kc. to 95 mc. in 8 bands. Coils for the two low-frequency bands are wound on 1½-inch diameter by 2¾-inch long ribbed forms. The 40 to 95 mc. coil is self supporting and mounted on a *Millen* #40104 isolantite plug. Remaining coils are wound on forms 1¼-inch in diameter by 2¼-inch long. Where the coils are spacewound, the turns should be cemented firmly in place to prevent change of calibration. Other coil ranges may be constructed as desired. If the circuit is to be used as an oscillator only, without the dip meter features, it is only necessary to shunt a coil across pins 1 and 4 of the coil socket. For low-frequency operation r.f. chokes shunted with additional capacity may be used.

Suitable taps are provided on each coil to allow coupling of the r.f. voltage into the diode voltmeter circuit. At high frequencies the taps must be near the ground end of the coil in order to prevent excessive loading of the oscillator with a consequent decrease in output. At low frequencies it is desirable to have the taps high up on the coil in order that the oscillator may be operated at a lower output, resulting in more sensitive dip indications. The tap on each coil is brought out to pin 2 of the coil form.

The indicator portion of the Multi-Dipper consists of a series diode r.f. voltmeter using a CK705 crystal diode and a 100 microamp meter. Any general purpose diode may be used in place of the CK705. A 500 microamp or a 1 milliamp meter may be used in place of the 100 microamp unit with somewhat less sensitivity. The oscillator has insufficient output on its highest frequency range to give a full-scale reading on a 1 ma. meter. Other features of the indicator circuit include a series phone jack and a meter shorting switch. The jack allows headphones to be inserted in the circuit for heterodyne measurements and phone monitoring. A variable or fixed resistor may be mounted on a phone plug and inserted in the jack in order to reduce the sensitivity of the meter. This feature is valuable when the circuit is used as an absorption wavemeter. It is not desirable to reduce the meter sensitivity when making dip measurements. Instead, the oscillator plate voltage must be adjusted to give the proper meter reading. Switch S_1 is ganged with the oscillator plate voltage control, R_2, and is arranged to short out the meter when R_2 is in its maximum resistance position corresponding to minimum oscillator voltage. For this arrangement it is necessary to use a single-pole, double-throw volume control switch.

The oscillator power supply uses a small "booster type" power transformer, a half-wave selenium rectifier, and a resistance-capacitance filter. The transformer shown in Fig. 4 measures 1¾" x 1½" x 1⅜" and has two secondary windings of 110 v. at 20 ma. and 6.3 v. at 0.3 amp. If a 6J6 is used in the oscillator, it will be necessary to obtain a transformer with a 0.45 amp. filament winding. Using the parts specified, the voltage at the junction of R_1 and R_3 will be approximately 80 volts under load. In order to reduce this to the value required for full-scale oscillator output a 200,000-ohm variable resistor, R_2, is inserted in series with the plates of V_1. This control should be arranged to have decreasing resistance with clockwise rotation.

A slide-type switch is used to control the current in the transformer primary. This type of switch takes up little space and is well suited to miniature equipment. If desired, a small male a.c. plug may be mounted on the chassis in order to allow disconnecting the power cord when the instrument is used as an absorption wavemeter. On the other hand, some constructors may desire to use a separate power supply. Any power supply capable of delivering 80 volts at 5 ma. may be used. Batteries may also be used. A 22.5 volt battery will be adequate if it is not necessary to use the two highest frequency ranges.

It should be pointed out that some hum modulation of the oscillator signal will be encountered when using a.c. on the heaters. This is due to operating the cathode above r.f. ground and is most severe when operating at low plate voltages.

Construction Details

Details of the author's construction may be seen in the photographs, Figs. 1 and 4. The entire unit is built up in a 5¼" x 3" x 2⅛" interlocking aluminum box. Of course, if a 2-inch meter or a larger tube or transformer are used, a larger box may be required. The author's method of construction places the oscillator and indicator portions of the instrument in one half of the box and the entire power supply in the other half.

In constructing the oscillator portion care must be taken to use the shortest possible leads, otherwise the minimum circuit capacitance and inductance will reduce the maximum usable frequency. For the same reason it is desirable to use the smallest possible components such as disc ceramic capacitors. In the construction shown, the variable capacitor has been so mounted that its ground terminal may be soldered directly to the coil socket, and its other terminal requires only a quarter-inch lead. Pin 7 of the subminiature tube socket is connected directly to the high side of the capacitor. The socket is supported entirely by its wiring. The tube is so light that no other support is required. A tie-point strip is positioned adjacent to the oscillator to allow termination of the power leads.

In the indicator portion of the instrument the crystal diode is connected directly between pins 2 and 3 of the coil socket with the cathode or positive terminal at pin 3. The bypass capacitor, C_2, is connected directly between pins 3 and 4. The meter, jack, and switch are located at the opposite end of the chassis.

Components in the power supply must be positioned in such a manner as to clear components in the other half of the box. Several tie-points are used to secure the small parts and to provide termination of the interconnecting leads. Proper construction methods for bringing in the a.c. lead include the use of a grommet and anchoring the cord securely.

Calibration

Although a calibrated dial is not essential, it is very handy for the frequent user of this instrument. Others may find it satisfactory to work from calibration charts or graphs. At any rate, a graph should be made up to provide the points to be transferred to the dial. A calibrated dial may be made by putting the calibrations on a stiff paper disc and gluing that to the back side of a metal dial. Another method is to draw up a scale twice as large as required and then make a half-size photostat to paste on the dial.

In determining the calibration points the oscillator control should be set to give the reading that will be used in operation. 80% of full scale on the meter should be satisfactory. The reason for taking this precaution is because the oscillator frequency varies somewhat with applied voltage. The frequency will also vary slightly with a change in loading. Therefore, placing headphones in the meter circuit will make a difference in the calibration. However, it is not reasonable to expect too high an accuracy of calibration since a dip meter is basically not a high accuracy instrument. It is no substitute for a frequency meter.

There are several methods that may be used to determine calibration points. The easiest method is to pick up the oscillator fundamental or harmonics on a calibrated all-wave receiver. On the higher frequencies an FM receiver may be used. The accuracy of this method is limited by the accuracy of the receiver calibration. An improvement would be to use a 100 kc. or other low-frequency crystal oscillator to provide markers on the receiver dial.

Another method of calibration is to use the Multi-Dipper as a heterodyne frequency meter and beat the oscillator signals against harmonics from a signal generator or transmitter. Since the signal, when heard in headphones, may be very weak, it may be desirable to patch the output into an audio amplifier. As already pointed out, changing the load in the indicator circuit may affect the accuracy of calibration.

Several other calibration methods suggest themselves. Among these are use of a heterodyne frequency meter. use of calibrated absorption wavemeters, and. at the higher frequencies, use of a Lecher wire system. The best method to use is the one which causes the least loading of the oscillator. Any method requiring coupling of the oscillator to an external circuit should use the loosest possible coupling.

Operation

The many uses of the dip meter do not need to be recounted here. Needless to say, it is a very versatile instrument when used around the ham shack or service shop for determining resonant frequencies of tuned circuits and antennas, checking values of inductance and capacitance. calibrating wavemeters, etc.

For operation as a dip meter the power is applied and the tube is allowed to warm up for a minute or so. The desired range is selected by plugging in the proper coil, and the sensitivity control should be adjusted to give a meter reading of about 80% of full scale. The dipper coil may then be coupled to the circuit under test. To start out, a close coupling is desirable in order to have a strong, easily detected dip as the capacitor is tuned through resonance. When the resonant point has been located, the coupling should be decreased to the lowest possible amount that will still give a slight dip. The dial may then be read to determine the resonant frequency with the greatest accuracy.

When the Multi-Dipper is to be used as an absorption wavemeter, the oscillator power is turned off. The coil is then brought close enough to a source of r.f. energy to give a meter reading when the tuning capacitor is tuned through resonance. There now will be a difference of 2 or 3 per-cent between the absorption wavemeter readings and the dip meter readings. A useful accessory for the wavemeter is a meter desensitizer for use with strong signals. This may consist of a resistor soldered across a phone plug, which may be plugged into the jack, adding series resistance to the meter circuit. A 15,000-ohm, ½-watt resistor will reduce the reading to 20 per-cent of its former value on the 100 microamp meter.

By coupling a 2- or 3-foot antenna directly to pin 2 of the coil, the Multi-

(*Continued on page* 106)

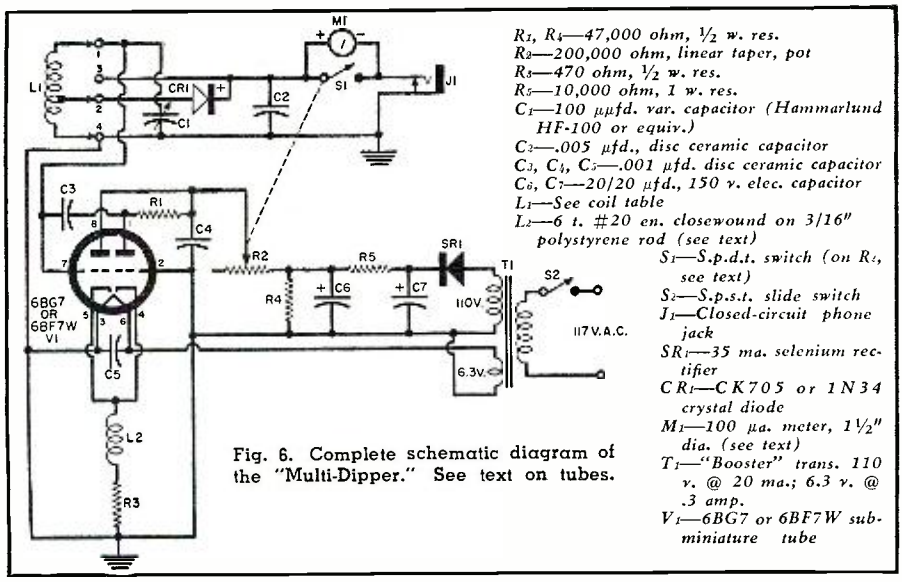
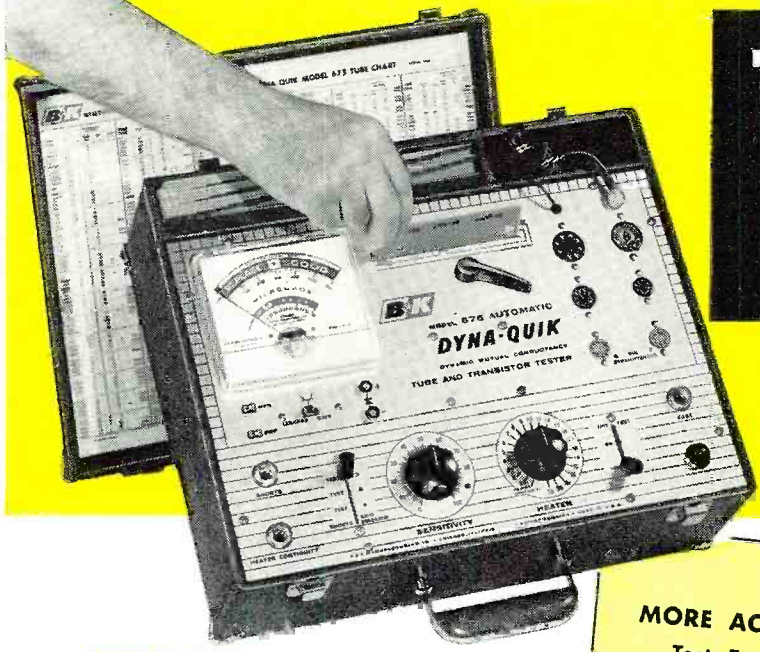


Fig. 6. Complete schematic diagram of the "Multi-Dipper." See text on tubes.

R_1, R_4—47,000 ohm, ½ w. res.
R_2—200,000 ohm, linear taper, pot
R_3—470 ohm, ½ w. res.
R_5—10,000 ohm, 1 w. res.
C_1—100 μμfd. var. capacitor (Hammarlund HF-100 or equiv.)
C_2—.005 μfd., disc ceramic capacitor
C_3, C_4, C_5—.001 μfd. disc ceramic capacitor
C_6, C_7—20/20 μfd., 150 v. elec. capacitor
L_1—See coil table
L_2—6 t. #20 en. closewound on 3/16" polystyrene rod (see text)
S_1—S.p.d.t. switch (on R_2, see text)
S_2—S.p.s.t. slide switch
J_1—Closed-circuit phone jack
SR_1—35 ma. selenium rectifier
CR_1—CK705 or 1N34 crystal diode
M_1—100 μa. meter, 1½" dia. (see text)
T_1—"Booster" trans. 110 v. @ 20 ma.; 6.3 v. @ .3 amp.
V_1—6BG7 or 6BF7W subminiature tube

You can do more than ever before with this new portable B&K

AUTOMATIC MONEY-MAKER



TESTS TUBES AND TRANSISTORS *Automatically*

WITH LABORATORY ACCURACY

- Saves Servicing Time
- Sells More Tubes
- Satisfies More Customers

B&K MODEL 675 AUTOMATIC DYNA-QUIK

DYNAMIC MUTUAL CONDUCTANCE TUBE & TRANSISTOR TESTER

MORE ACCURATE TEST

Tests Each Section of Multiple Tubes Separately for Gm, Shorts, Grid Emission and Life

Tests each tube for Gas Content and Grid Emission simultaneously with Short check.. Instantaneous Heater Continuity test.

SIMPLIFIED AUTOMATIC DYNA-CARD SYSTEM

With only 60 heavy-duty, phenolic Dyna-Cards you can test over 500 tube types. Dyna-Card automatically sets socket connections for quick, accurate test. Each Dyna-Card is identified and indexed, ready to use. Always kept up-to-date simply by adding new Dyna-Cards. Minimizes obsolescence.

CHECKS OVER 99%

of the tubes most widely used in television receivers plus popular home and portable radio tubes.

ONE EXTRA TUBE SALE

on each of 5 calls a day pays for the Dyna-Quik in a few weeks.

TESTS TRANSISTORS, TOO

Transistor Section checks junction, point contact and barrier transistors, germanium and silicon diodes, selenium and silicon rectifiers.

Again, B&K helps servicemen give *faster, better service at less cost and make more money*. The new *automatic* Model 675 makes tube checking quick and easy in the home or shop. (Tests transistors, too.) *Measures true dynamic mutual conductance*. Makes complete tube test in seconds, under actual operating conditions of the set. Checks average set in a few minutes. Simple to operate. *No multiple switching. No roll chart*. Shows customer the true condition and life expectancy of tubes in the set, *sells more tubes on-the-spot, saves call-backs*. Quickly pays for itself.

Shows tube condition on "Good-Bad" scale and in micromhos. Large 4½" meter has two highly accurate ranges calibrated 0-6000 and 0-18,000 micromhos. 7-pin and 9-pin straighteners are mounted on panel. Automatic line compensation. Special bridge monitors line voltage continuously. Light weight, easily portable in handsome leatherette-covered carrying case. Operates on 105-125 volts 60 cycle a.c. Size: 15¼" x 12¼" x 6". Net wt: 10½ lb. Net, **$169.95**

Also makers of famous CRT, DYNA-SCAN, CALIBRATOR

See your B&K Distributor, or write for Bulletin AP12-N

B&K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois

Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont. Export: Empire Exporters, 458 Broadway, New York 13, N.Y.

"HEATHKITS®

gave me my start and I'm still sold!"

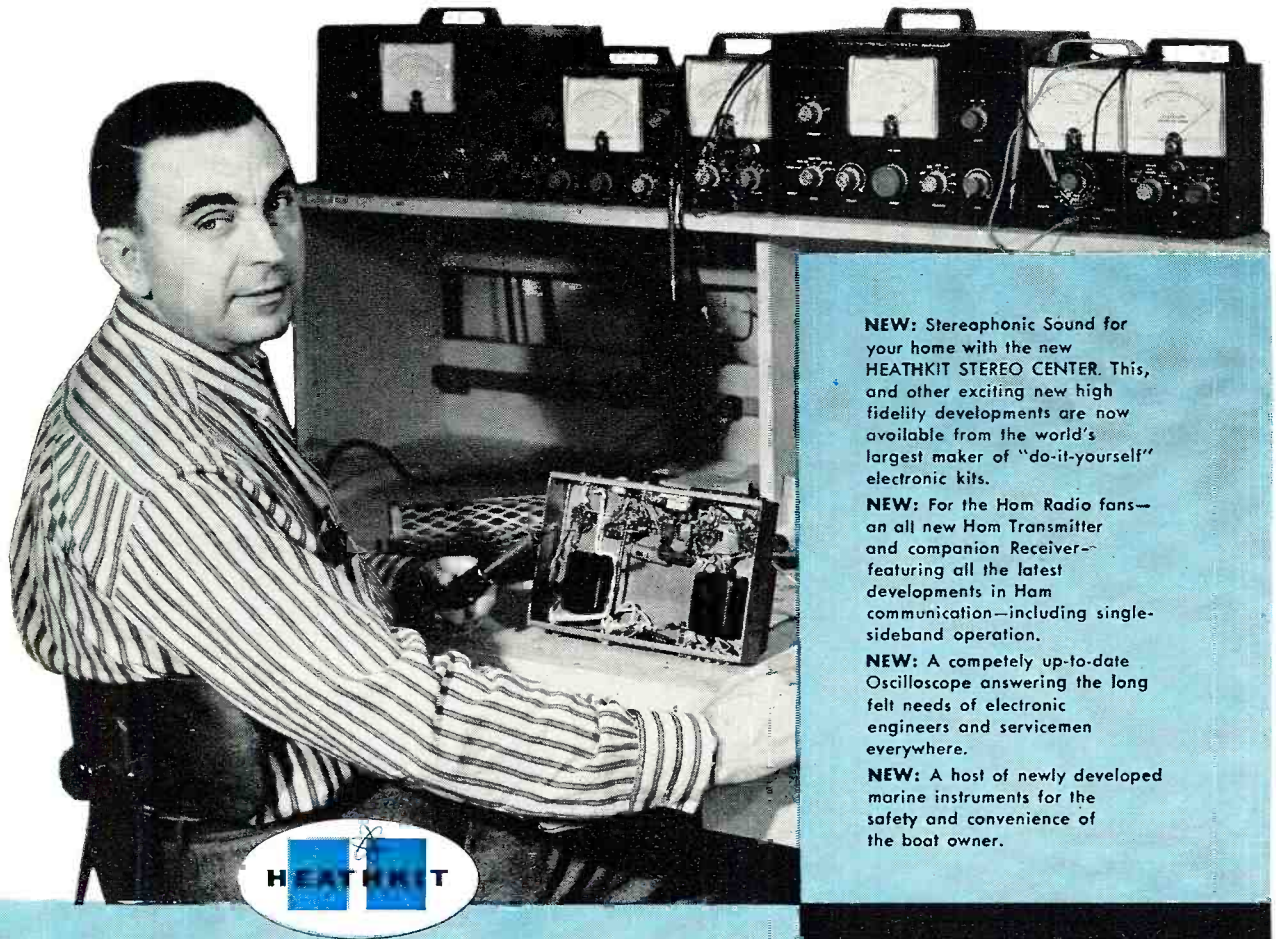
" . . . they are my lowest cost way to real quality and dependability in electronic equipment of any kind . . .

. . . The clean, modern styling of HEATHKITS make me proud to own them. They make a handsome and useful addition to my workshop.

. . . Rigid quality standards of components used in HEATHKITS assure me of performance equal to or surpassing instruments costing many times more.

. . . after assembling a HEATHKIT myself, I know what "makes it tick". . . I know that the thoughtful circuitry design and name-brand components used throughout guarantee me years of trouble-free service.

. . . HEATHKITS cost me half as much as ordinary equipment . . . and I get so much more. In assembling my own instruments I am sure of the quality that goes into them. Plus the complete assembly and operating instructions as well as detailed schematics that are at my fingertips for future reference."



NEW: Stereophonic Sound for your home with the new HEATHKIT STEREO CENTER. This, and other exciting new high fidelity developments are now available from the world's largest maker of "do-it-yourself" electronic kits.

NEW: For the Ham Radio fans—an all new Ham Transmitter and companion Receiver—featuring all the latest developments in Ham communication—including single-sideband operation.

NEW: A competely up-to-date Oscilloscope answering the long felt needs of electronic engineers and servicemen everywhere.

NEW: A host of newly developed marine instruments for the safety and convenience of the boat owner.

HEATHKIT

HEATH COMPANY Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.

The HEATH TIME PAYMENT PLAN allows you to outfit your whole workshop at one time with needed test instruments while you pay in easy monthly installments.

HEATHKIT

PROFESSIONAL OSCILLOSCOPE KIT

An exciting development in the Heathkit test instrument line is the introduction of the Heathkit model OP-1 Professional Oscilloscope. Emphasizing complete flexibility in any application, the OP-1 features DC coupled amplifiers and also DC coupled CRT tube un-blanking. The triggered sweep circuit will operate on either internal or external signals and may be either AC or DC coupled. The polarity of the triggering signal may also be selected, and any point on the wave form may be selected for the start of the sweep by using the "triggering level" control. An automatic position is also provided, in which the sweep recurs at a 50 cycle rate, but can be driven over a wide range of frequencies with no additional adjustments. The sweep frequencies are provided by switch-selected base rates of 2 and .2 milliseconds/CM, and 20, 2, and 1 microseconds/CM, in conjunction with a continuously variable 10 to 1 multiplier. Sweep frequencies are calibrated to within 10% at all control settings, and the sweep frequency may be reduced by adding capacity to the "ext. cap" binding post on the front panel. A 5ADP2 flat face CR tube is used for accurate readings on an edge lighted grid screen. A high quality conetic-fernetic CR tube shield prevents stray AC fields from distorting trace. A 12-position vertical attenuator is calibrated in volts-per-CM and the horizontal sweep is calibrated in time-per-CM. Prewired terminal boards are used for rapid, easy assembly of all critical circuits. Simply install and connect the color coded leads. Power supply is transformer operated utilizing silicon diode rectifiers and is fused for protection. Under development for over a year the OP-1 promises outstanding results in any application requiring the use of an oscilloscope.

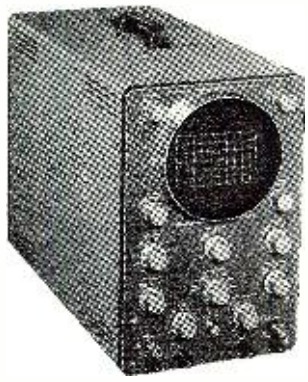
HEATHKIT OP-1 $179.95

Here's the scope you've been waiting for!

AVAILABLE AFTER JUNE 15

Laboratory Performance At Less Than Utility Scope Price

HEATHKIT O-12 $64.95



A Scope You Will Be Proud To Own

HEATHKIT OM-3 $39.95

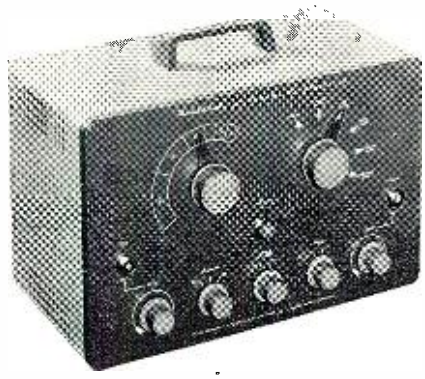
"EXTRA DUTY" 5" OSCILLOSCOPE KIT

Top quality features at half the cost of ordinary equipment sum up the advantages of this popular kit. Critical observations in your laboratory or shop are handled easily, with clear, sharp pattern displays in every application. Vertical frequency response extends from 3 CPS to 5 mc +1.5 db —5 db without extra switching. Response is down only 2.2 db at 3.58 mc. The Heath patented sweep circuit functions effectively from 10 CPS to better than 500 kc in five steps, giving you 5 times the usual sweep obtained in other scopes. An automatic sync circuit with self-limiting cathode follower provides excellent linearity and lock-in characteristics. Extremely short retrace time and efficient blanking action. Both vertical and horizontal output amplifiers are push-pull and the scope incorporates a 1 V peak-to-peak calibrating source, step attenuated and frequency compensated vertical input, plastic molded capacitors and top quality parts throughout. The 11-tube circuit features a 5UP1 cathode ray tube, and provision is made for Z-axis input for intensity modulation of the beam. Frequency response of the horizontal amplifier is within ±1 db from 1 CPS to 200 kc. Horizontal sensitivity is 0.3 volts RMS per inch. Construction is simplified through the use of two metal circuit boards and precut, cable wiring harness. Shpg. Wt. 22 lbs.

GENERAL PURPOSE 5" OSCILLOSCOPE KIT

For servicing and routine laboratory work this fine kit is a favorite with technicians throughout the country. It incorporates many extras not expected at this low price. Features wide vertical amplifier frequency response, extended sweep generator operation, and improved stability. Frequency response of the vertical amplifier is within ± 3 db from 4 CPS to 1.2 mc. Vertical sensitivity is .09 volts RMS per inch at 1 kc. Sweep generator functions reliably from 20 CPS to over 150 kc. A modern etched circuit board is featured for high stability and reduces assembly time considerably. Standard components are mounted on this board with each position clearly marked preventing wiring errors. Both vertical and horizontal amplifiers are push-pull types. Uses a 5BP1 CRT. Provision for external or internal sweep or sync, built in 1 V peak-to-peak reference voltage and calibrated grid screen. An adjustable "spot shape" control is provided to insure a sharp trace. Input to the vertical amplifiers is through a step attenuated, frequency compensated circuit. The OM-3 is an extremely versatile instrument and has a multitude of practical uses in electronic testing fields. Particularly useful in alignment of television receivers, for testing audio amplifiers and circuits, and checking the quality of modulated RF signals in Ham Radio transmitters. Shpg. Wt. 22 lbs.

Equip Your Service Bench...



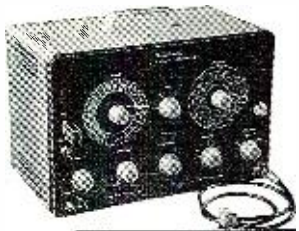
HEATHKIT CD-1 **$59.95**

Cash In Now On Color TV

★ 10 VERTICAL COLOR BARS
★ CRYSTAL CONTROLLED ACCURACY
★ CHOICE OF 6 DIFFERENT PATTERNS

COLOR BAR AND DOT GENERATOR KIT

Colored television is now a reality and as the number of these sets increase the need for a reliable service instrument is apparent. Nothing on the market . . . in this type of generator has as many features as the CD-1 at such a tremendous price saving. This unit combines two basic color service instruments, a color bar generator, and white dot generator in one versatile portable unit which has crystal controlled accuracy and stability for steady locked-in patterns (requires no external sync leads). Color receivers converged with the CD-1 will still be converged properly on a television program from the station. The 13-tube circuit has been carefully laid out for ease of assembly and provides choice of six different patterns. Produces white-dots, cross hatch, horizontal and vertical bars, ten vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-on switch. Voltage regulated power supply uses long-life silicon rectifiers. Kit includes three crystals and test lead, plus an information packed instruction manual covering convergence, and screen and background adjustments of a color TV set. Compare with other generators on the market and you will see that this instrument is loaded with extras and top quality all the way through. Shpg. Wt. 13 lbs.



HEATHKIT TS-4A **$49.50**

For fast, easy alignment of TV sets

HEATHKIT AG-10 **$49.95**

Sine and square waves for countless uses

HEATHKIT MM-1 **$29.95**

High accuracy in a portable meter

HEATHKIT M-1 **$17.95**

An all-round meter of many uses

TV ALIGNMENT GENERATOR KIT

This generator has many special design features for flexible, easy operation and reliability. The all-electronic sweep circuit insures stability and covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. Crystal and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking and phasing control also provided. A truly outstanding number of features at a tremendous price saving. Shpg. Wt. 16 lbs.

SINE-SQUARE GENERATOR KIT

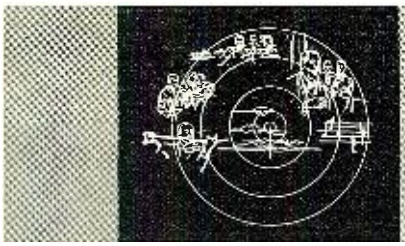
High quality sine and square waves are produced by this generator over a wide range. Frequency response is ±1.5 db from 20 CPS to 1 mc on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Output impedance is 600 ohms on sine wave and 50 ohms on square wave (except on 10 volt range). Square wave rise time less than .15 microseconds. Five-position bandswitch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1 and .1 volts with extra range of .01 volt on sine wave. Shpg. Wt. 12 lbs.

20,000 OHMS/VOLT VOM KIT

This meter is ideal for use in field applications where accuracy is important. Employs a 50 ua 4½" meter, and features 1% precision multiplier resistors for high accuracy. Requires no external power for operation (batteries supplied). Sensitivity is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5,000 volts AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are x 1, x 100 and x 10,000. Covers -10 db to +65 db. Batteries and test leads are also included with this kit. Shpg. Wt. 6 lbs.

HANDITESTER KIT

Small enough to carry with you wherever you go, this fine handitester is ideal for use in portable applications when making tests away from the work bench or as an "extra" meter in the service shop, when the main instruments are occupied. The combination function-range switch simplifies operation. Measures AC or DC voltage from 0-10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000. Top quality precision components employed throughout. Very popular with home experimenters and electricians. Shpg. Wt. 3 lbs.

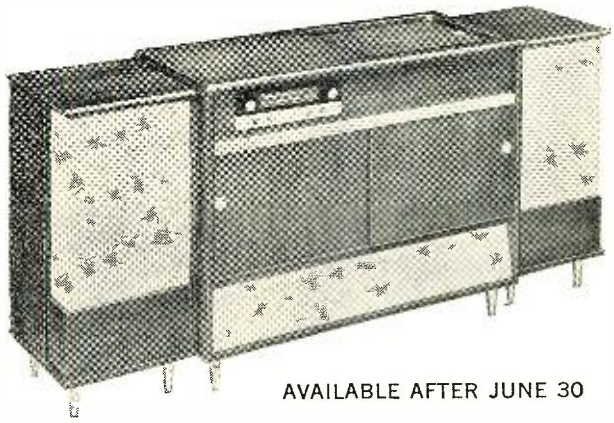


Enjoy Real 3 Dimension Sound...

Beautifully Styled with Plenty of Room for the Most Complete Stereo System

AVAILABLE IN THE FOLLOWING MODELS:
Model SE-1B—Stereo Equipment Cabinet (birch)
Model SE-1M—Stereo Equipment Cabinet (mahogany)
$149.95 ea.

Model SC-1BR—Stereo Wing Speaker Enclosure (birch—right end)
Model SC-1BL—Stereo Wing Speaker Enclosure (birch—left end)
Model SC-1MR—Stereo Wing Speaker Enclosure (mahogany—right end)
Model SC-1ML—Stereo Wing Speaker Enclosure (mahogany—left end)
$39.95 ea.



AVAILABLE AFTER JUNE 30

STEREO EQUIPMENT CABINET KIT

Imagine!... Stereophonic sound in your own home. This superbly designed cabinet holds all of your hi-fi stereo equipment and lends striking elegance to your living room. The attractive gold and black panels, trim and hardware brilliantly highlight the overall effect. Rich toned grille cloth, flecked in gold and black, complement the cabinet. The unit has ample room provided for an AM-FM tuner, tape deck, stereo preamplifier, amplifiers, record changer, record storage and speakers. Beautifully grained ¾" solid core Philippine mahogany or select birch plywood is used for construction. The top features a shaped edge and sliding top panel for easy access to the stereo tape deck and stereo preamplifier. Sliding doors are employed for convenient front access to the changer and record storage compartment. All parts of the cabinet are precut and predrilled for simple assembly. The speaker wings and center cabinet may be purchased separately if desired. Note: the kit is delivered equipped with panels precut to accommodate Heathkit components and also blank panels to cut out for your own equipment. Measurements of the individual component areas follow: tape deck and preamplifier area 20¾" L. x 17¾" W. x 10" D., record changer area 21" W. x 16" D. x 9⅝" H., record storage area 22⅝" W. x 14½" H. x 12½" D., speaker wing area (inside) 14" W. x 29½" H. x 15¾" D., AM-FM Tuner area 20½" W. x 5¼" H. x 14" D., amplifier (2 areas) 15¼" W. x 10¾" H. x 13¼" D.

Model HH-1B Birch
Model HH-1M Mahogany
Now only **$299.95** each

The Same Superior Performance At a New Low Price

HEATHKIT SS-2 **$39.95**

OPTIONAL LEGS EXTRA

Economical Hi-Fi For Your Home

"LEGATO" HI-FI SPEAKER SYSTEM KIT

The increasing sales of the Legato has made more economical quantity production possible so we are passing the savings on to you by offering you this magnificent speaker system at a reduced price. Truly a "queen" among hi-fi speaker systems, the Legato was specially designed to meet and surpass the most stringent requirements of high fidelity sound reproduction. Two 15" Altec Lansing low frequency drivers cover frequencies of 25 to 500 CPS while a specially designed exponential horn with high frequency driver covers 500 to 20,000 CPS. A unique crossover network is built in making electronic crossovers unnecessary. Internal reflections are absorbed by splayed back panel and a 3" fiber glass lining. The Legato emphasizes simplicity of line and form to blend with modern or traditional furnishings. Cabinet construction is ¾" veneer surface plywood in either African mahogany or white birch and measures 41" L. x 22¼" D. x 34" H. All parts are precut and predrilled for easy assembly. Shpg. Wt. 195 lbs.

"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

True high fidelity performance at modest cost make this basic speaker system a spectacular buy for any hi-fi enthusiast. The amazing performance of this popular kit is made possible by the use of high quality speakers in an enclosure specially designed to receive them. The cabinet is a ducted port bass reflex type enclosure 11½" H. x 23" W. x 11¾" D. It features an 8" mid range woofer to cover 50 to 1600 CPS and a compression-type tweeter with flared horn covering 1600 to 12,000 CPS. Both speakers are by Jensen. The adjustable flared tweeter horn allows speaker to be used in either upright or horizontal position. The cabinet is constructed of ½" veneer surfaced plywood suitable for light or dark finish of your choice. All wood parts are precut and predrilled for easy assembly. Shpg. Wt. 25 lbs.

Attractive brass tip accessory legs convert SS-2 into attractive consolette. Legs screw into brackets provided. All hardware included. Shpg. Wt. 3 lbs. No. 91-26 $4.95

with a Heathkit Stereo System

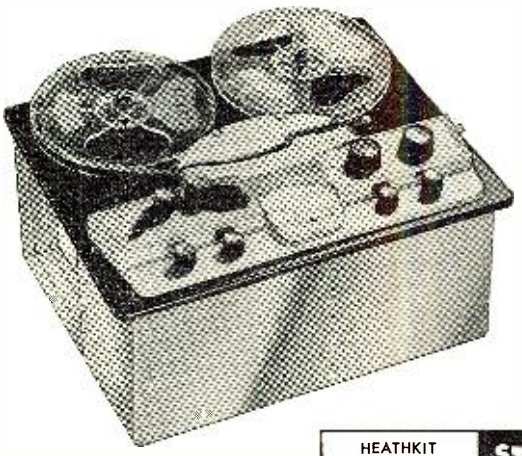
HEATHKIT

HIGH FIDELITY STEREO TAPE DECK KIT

For your unparalleled enjoyment in the world of stereophonic sound Heathkit brings you an all new stereo tape deck. This tape deck is a precision engineered instrument providing monaural record/playback, and stereo playback of prerecorded tapes. Incorporates three separate heads, erase-record-stereo playback (stacked). The mechanical tape deck assembly is supplied complete. You build only the record and playback circuit employing two etched circuit boards for ease of wiring. Low noise EF-86 tubes in input stages and efficient push-pull bias-erase oscillator insures complete freedom from hum and noise in recording and playback. Provision made for 3¾ and 7½ IPS tape speed selected by a push button. Deck handles up to 7" reels of tape. Other features are: provision for monitoring tape while recording, built in VU meter for proper recording level, pause control for editing tape, "fast forward" and "rewind" control. Frequency response at 7½ IPS tape speed is ±2 db from 40 to 12,000 CPS, at 3¾ IPS speed 40 to 6,000 CPS. Signal-to-noise ratio is 55 decibels with less than 1% total harmonic distortion. NARTB tape playback equalization. A safety interlock button prevents accidentally switching to record position causing erasure of recorded tapes. Shpg. Wt. 33 lbs.

Model TR-1C monaural tape deck incorporates all of the features described for the model TR-1D with the exception of stereo playback. $131.95.

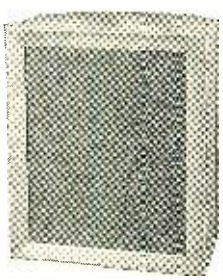
No. C-TR-1C conversion kit converts model TR-1C to include stereo function of model TR-1D. $15.95.



HEATHKIT TR-1D **$143.95**

Preassembled Tape Mechanism . . . You Build Only Electronic Circuit

AVAILABLE AFTER JUNE 30



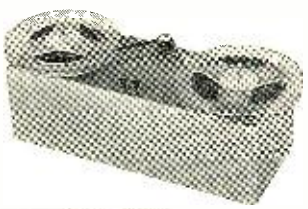
HEATHKIT SS-1B **$99.95**

Fill out the Hi-Fi Range of Your SS-2 Speaker

"RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

This is not a complete speaker system in itself, but is designed to extend the range of the SS-2. The SS-1B uses a 15" woofer and a small super tweeter to supply the very high and very low frequencies to fill out the response of the basic SS-2. The SS-2 and SS-1B when used together, form an integrated four speaker system. The SS-2 and SS-1B combination provide an overall response of ±5 db from 35 to 16,000 CPS. The kit includes circuit for crossover at 600, 1600 and 4,000 CPS. Impedance is 16 ohms and power rating is 35 watts. A control is also provided to limit output of super tweeter. The handsome cabinet measures 29" H. x 23" W. x 17½" D. Constructed of beautiful ¾" veneer surface plywood. Complete step-by-step instructions make this kit easy to build. No woodworking experience required. Shpg. Wt. 80 lbs.

AVAILABLE AFTER JUNE 30



HEATHKIT SW-1 PRICE TO BE ANNOUNCED

Save Time Rewinding Tape

"SPEEDWINDER" KIT

This handy device leaves your tape recorder free for operation while it rewinds tape at the rate of 1200' in 40 seconds. Prevents unnecessary wear to the tape and recorder by eliminating wear against guides and heads. It will handle up to 10½" tape reels as well as 800' reels of 8 and 16 millimeter film. A very useful aid to operators of movie projection equipment. The Heathkit Speedwinder features an automatic shutoff which prevents whipping of tape when it has rewound. A manual shutoff is also provided. An automatic braking device is built in for protection against power failure. Driven by a heavy duty four pole motor. Handsome cabinet is constructed of furniture grade plywood. Step-by-step instructions are provided to make this kit easy to assemble even by one with no experience.

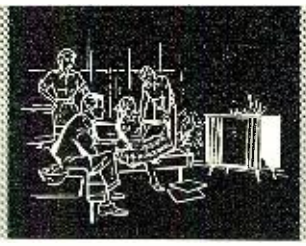
HEATHKIT TK-1 **$9.95**

All The Tools You Need For Building Heathkits

COMPLETE TOOL SET

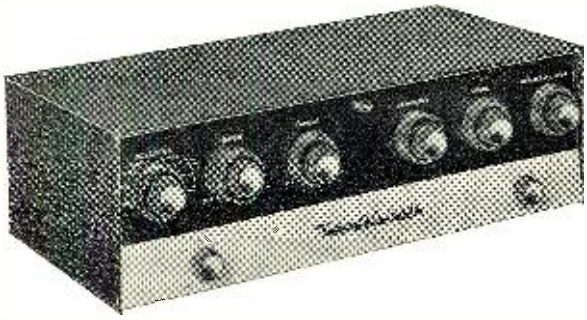
A clear illustration of just how easy Heathkit building is. The pliers, diagonal sidecutters, two screw drivers and soldering iron are all the basic tools you need for building practically any Heathkit. Pliers and sidecutters are equipped with insulated rubber handles. The American Beauty soldering iron has a replaceable tip to facilitate cleaning. All the tools are of top quality case hardened steel for rugged duty and long life. With these simple, inexpensive tools in your hand you need not be afraid to tackle the most elaborate kit. The manual included with this handy kit provides you with many useful tips on the use and care of your tools. It shows the all important step of making proper solder connections. A truly worthwhile investment for the beginner in electronic kit building. Shpg. Wt. 3 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • Benton Harbor 15, Mich.



Plan Your Hi-Fi System...

AVAILABLE AFTER JUNE 30



HEATHKIT SP-2 **$56.95**

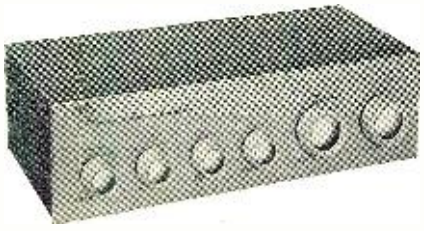
Model SP-1 (monaural) $37.95

Model C-SP-1 (converts SP-1 to SP-2) $21.95

Control both stereo channels simply and conveniently

MONAURAL-STEREO PREAMPLIFIER KIT

This expertly designed preamplifier provides all the controls required for either standard monaural (single channel) or stereo (dual channel) sound reproduction. Features building block design . . . you can start with a basic preamplifier and add a second channel for stereo later on, without rewiring. Second channel plugs in for fast conversion. The complete model SP-2 (stereo) features twelve separate inputs, six on each channel with input level controls. Six dual-concentric controls consist of: two 8-position selector switches, two bass, two treble, two volume level and two loudness controls, a scratch filter switch and a 4-position function switch (separate on-off switch). The function switch provides settings for stereo, two-channel mix, channel A or B for monaural use. Inputs consist of tape, mike, mag phono and three high-level inputs. Tape input has NARTB equalization and input selector provides for RIAA, LP, 78 record compensation. EF86 tubes are used in the input stages along with hum balance controls to assure low hum and noise. Two cathode follower outputs with level controls provided in addition to two separate tape outputs for stereo recording. A remote balance control with twenty feet of cable allows balancing the stereo system from listening position. Construction is greatly simplified through the use of two printed circuit boards (one in each channel) and encapsulated printed circuits. The beautiful vinyl clad steel cover has leather texture in black with inlaid gold design. Built-in power supply.

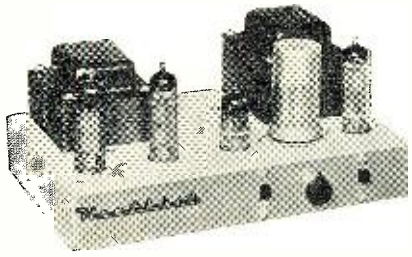


HEATHKIT WA-P2 **$19.75**

Finger-tip controls for your operating convenience

"MASTER CONTROL" PREAMPLIFIER KIT

Designed as a control center for basic amplifiers the WA-P2 provides you with true high fidelity performance for the finest audio systems. Five switch-selected inputs accommodate a record changer, tape recorder, AM-FM tuner, TV receiver, microphone, etc., each with level control. Provision is also made for a tape recorder output. Ideal for "remote" installations, the WA-P2 features a low impedance cathode-follower output circuit allowing greater length of output lead. Full frequency response is obtained within ±1½ db from 15 to 35,000 CPS and will do full justice to the finest available program sources. Equalization is provided for records through separate turnover and rolloff switches for LP, RIAA, AES, and early 78's. A special hum balance control allows setting for minimum hum level. Power for operation is required from basic amplifier or external source. Shpg. Wt. 7 lbs.



HEATHKIT UA-1 **$21.95**

A low cost versatile performer

"UNIVERSAL" 12-WATT AMPLIFIER KIT

A true high fidelity performer in every sense of the word, the UA-1 makes an ideal basic amplifier for any hi-fi system and is a perfect addition to gear your present hi-fi system for stereo sound. Uses 6BQ5/EL84 push-pull output tubes for less than 2% harmonic distortion throughout the entire audio range (20 to 20,000 CPS) at full 12 watt output. The on-off switch is located right on the chassis and an octal socket is provided for connecting a preamplifier for remote control operation. The specially designed output transformer provides excellent stability and frequency response. Taps for 4, 8 and 16 ohm speakers, with switched damping for "unity" or "maximum" on the 16-ohm tap. An input level control is provided for use in wired music systems where a preamplifier is not required. This versatile unit is the latest addition to the fine line of Heathkit basic amplifiers. Shpg. Wt. 13 lbs.

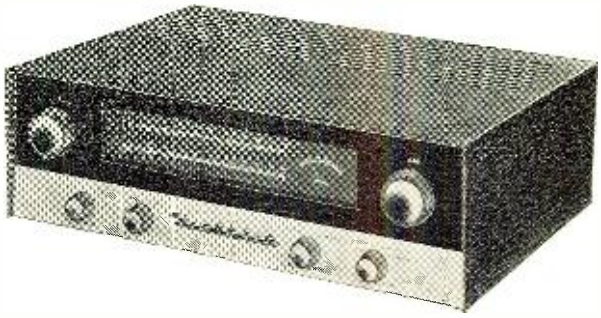
With Flexible Heathkit Components

HEATHKIT

DELUXE AM-FM TUNER KIT

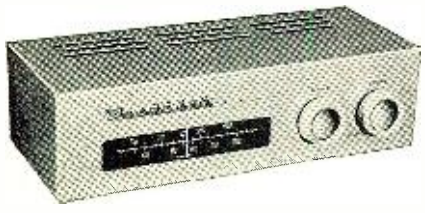
Outstanding features in both styling and circuitry are combined in this 16-tube deluxe AM-FM combination tuner to bring you the very finest in program sources, for your listening enjoyment. Features include three circuit boards for easy construction and high stability—prewired, prealigned FM front end—built-in AM rod antenna—tuning meter—AFC (automatic frequency control) with on-off switch and flywheel tuning. AM and FM circuits are separate and individually tuned making it ideal for stereo applications. Cathode follower outputs with individual controls are provided for both AM and FM. Other features include variable AM bandwidth, 10 kc whistle filter, tuned-cascode FM front end, FM AGC and amplified AVC for AM. The unique IF limiter design automatically provides the number of limiting and IF stages required for smooth non-flutter reception. The silicon diode power supply is extremely conservatively rated and is fuse protected assuring long service life. A tuning meter shows when the station is tuned-in for clearest reception on AM or FM. Use of three circuit boards greatly simplifies construction of circuit, you do only a minimum of wiring. All IF transformers and coils are prealigned so it will be ready to operate as soon as construction is completed. Appearance of this top-quality unit is further enhanced by the vinyl-clad steel cover in black with inlaid gold design. A multiplex jack is provided for addition of converter unit to receive multiplex stereo broadcasts on FM. A top dollar value.

AVAILABLE AFTER JUNE 30



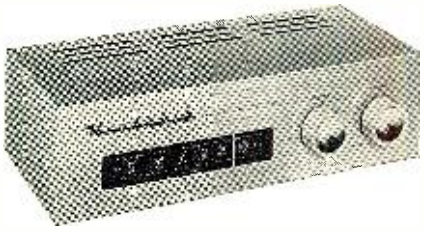
HEATHKIT PT-1 **$89.95**

A deluxe AM-FM tuner combination loaded with extras!



HEATHKIT BC-1A **$25.95**

Wide range broadcast reception



HEATHKIT FM-3A **$25.95**

Enjoy static-free FM entertainment

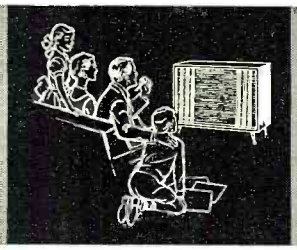
HIGH FIDELITY AM TUNER KIT

This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuit features broad bandwidth to assure low signal distortion. Audio response is ±1 db from 20 CPS to 9 kc, with 5 db of pre-emphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent and the tuner covers the entire broadcast band from 550 to 1600 kc. Quiet performance is assured by a 6 db signal-to-noise ratio at 2.5 uv. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

HIGH FIDELITY FM TUNER KIT

FM programming, your least expensive source of high fidelity will provide you with years of real enjoyment. This beautifully styled FM tuner features broad-banded circuits for full fidelity and better than 10 uv sensitivity for 20 db of quieting to pull in stations with clarity and full volume. Covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit, making special alignment equipment unnecessary. Edge-lighted glass slide rule dial for easy tuning. You need not wait to have FM in your home at this low price. Shpg. Wt. 8 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • **Benton Harbor 15, Mich.**



You can be sure you're buying High Fidelity

HEATHKIT W-7M **$54.95**

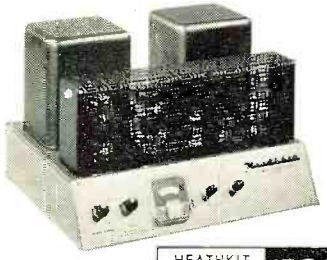
55 watts of hi-fi power at only $1 per watt

★ BEAUTIFULLY STYLED IN BLACK AND GOLD

★ UNITY OR MAXIMUM DAMPING

"EXTRA PERFORMANCE" 55 WATT HI-FI AMPLIFIER KIT

Another Heathkit first! An honestly rated high power amplifier with many top quality features at less than a dollar per watt. Full audio output is conservatively rated at 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout the entire range. Unique paired output connections permit instant switch selection of "unity" or "maximum" damping factors for all 4, 8 or 16 ohm speakers. Each output has an optimized current feedback circuit for unity damping so that there will be no compromise in performance when any of the impedances is used. This current feedback circuitry is entirely shorted out when not in use to obtain the highest possible damping factor. Features include level control and "on-off" switch right on the chassis plus provision for remote control from preamp, etc. Famous "bas-bal" circuit conveniently balances EL-34 output tubes. These heavy duty push-pull tubes operate into a high quality tapped-screen transformer designed especially for this unit. A 70-volt output on the transformer provides for P.A. or large music systems. The silicon diode power supply features a protection device that controls current until tubes have warmed up, greatly increasing service life of all components. The stylish black and gold case measures 6" H. x 8½" D. x 15" W. Convenient pilot light on the chassis. Thoughtful circuit layout makes this kit easy to build. Dollar for watt you can't beat this buy. Shipped express only. Shpg. Wt. 28 lbs.



HEATHKIT W-6M **$109.95**

Plenty of Reserve Power Without Distortion

"HEAVY DUTY" 70-WATT HI-FI AMPLIFIER KIT

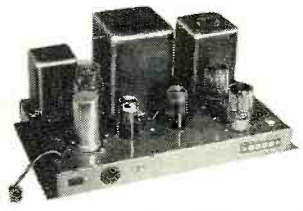
Here is an amplifier that will provide the extra "push" needed to drive any of the fine speaker systems available today, for truly fine performance at any power level. Silicon-diode rectifiers are used to assure long life and a heavy duty transformer gives you extremely good power supply regulation. Variable damping control provides optimum performance with any speaker system. Quick change plug selects 4, 8 and 16 ohms or 70 volt output and the correct feedback resistance. Frequency response at 1 watt is from 5 CPS to 80 kc with controlled HF rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 CPS and IM distortion is below 1%, 60 and 6,000 CPS. Hum and noise 88 db below full output. Metered balance circuit. Designed especially for easy assembly and years of dependable service. Shipped express only. Shpg. Wt. 52 lbs.

HEATHKIT W-5M **$59.75**

Top-Flight Performance for the Critical Listener

25-WATT HI-FI AMPLIFIER KIT

Considered top value in its power class by leading independent research organizations, the W-5M incorporates all the design features required by the super critical listener. Features include a specially designed Peerless output transformer and KT66 tubes. The circuit is rated at 25 watts and will follow instantaneous power peaks of a full orchestra up to 42 watts. A "tweeter saver" suppresses high frequency oscillation and a new type balancing circuit facilitates adjustment of the "dynamic" balance between output tubes. Frequency response is ±1 db from 5 CPS to 160,000 CPS at 1 watt and within 2 db from 20 to 20,000 CPS at full 25 watts output. Harmonic distortion is less than 1% at 25 watts and IM distortion is 1% at 20 watts (60 and 3,000 CPS, 4:1). Hum and noise are 99 db below 25 watts for truly quiet performance. Rich black and gold colored styling. Shipped express only. Shpg. Wt. 31 lbs.



HEATHKIT W4-AM **$39.75**

Faithful Sound Reproduction with Minimum Investment

20-WATT HI-FI AMPLIFIER KIT

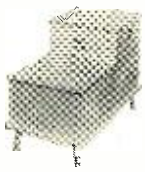
This fine amplifier will amaze you with its outstanding performance. It features a true Williamson circuit with extended frequency response, low distortion, and low hum levels. Enjoy true hi-fi with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-Standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extends from 10 CPS to 100 kc within ±1 db at 1 watt assuring you of full coverage of the audio range. Clean, clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms to match the speaker system of your choice. An outstanding performer, this investment will bring you years of listening enjoyment. Shipped express only. Shpg. Wt. 28 lbs.

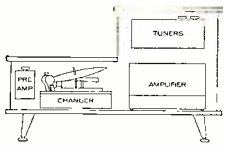
All basic amplifiers recommended for use with model WA-P2, SP-1 or SP-2 preamplifiers

Easy to Buy – Easy to Build – Easy to Use...

HEATHKIT
CE-1
$43.95 each

CONTEMPORARY
Model CE-1B Birch
Model CE-1M Mahogany





TRADITIONAL
Model CE-1T Mahogany

Combine all your Hi-Fi equipment in this attractive cabinet

CHAIRSIDE ENCLOSURE KIT

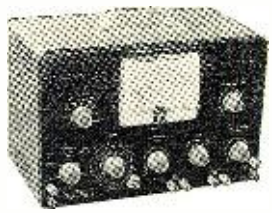
This Chairside Enclosure lets you combine all of your hi-fi equipment into one compact control center and, at the same time add a beautiful piece of furniture to your home. The CE-1 is designed to house the AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier along with the majority of record changers which will fit into the space provided. Adequate room is available in the rear of the unit to house any of the Heathkit amplifiers designed to operate with the WA-P2. The enclosure is flexible enough to give you a large choice in component installation. If only one tuner and the preamplifier are used, the two units can be installed in the tilt-out drawer, or if more convenient, either unit can be placed in the space provided in front of the changer compartment. The tilt-out shelf can be installed on either right or left side and the lift-top lid is similarly designed to lift from either side depending on your choice during construction. Good ventilation is achieved through appropriately placed slots in the bottom and back of the enclosure. Overall dimensions are 18"W. x 24" H. x 35½" D. The changer compartment measures 17¾" L. x 16" W. x 9⅝" D. All parts are precut and predrilled for easy assembly and attractive hardware is supplied to match each style. The contemporary cabinet is available in either mahogany or birch and the traditional cabinet is available in mahogany only. Furniture grade plywood can be finished to your taste. Shpg. Wt. 46 lbs.

HEATHKIT
AG-9A
$34.50

Your own source of Hi-Fi audio signals

AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals from 10 CPS to 100 kc. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1, 3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 CPS. Shpg. Wt. 8 lbs.



HEATHKIT
AA-1
$49.95

3 Audio test instruments in one compact unit

AUDIO ANALYZER KIT

Complete high fidelity testing facilities are yours in the AA-1. It combines the functions of three separate instruments; an AC VTVM, audio wattmeter and a complete IM analyzer with filters and high and low frequency oscillators built in. VTVM ranges are: 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Db scale reads from −65 to +52 dbm. Wattmeter ranges are: .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. IM scales are 1%, 3%, 10%, 30% and 100% full scale. Provides internal load resistors of 4, 8, 16 or 600 ohms. Combining and consolidating functions reduces the number of test leads and controls required for the same test. Complete instructions are provided for easy assembly, also valuable information on use of instrument. Shpg. Wt. 13 lbs.

HEATHKIT
HD-1
$49.50

Check amplifier distortion quickly

HARMONIC DISTORTION METER KIT

Valuable in both designing and servicing of audio circuits, the HD-1 used with an audio signal generator, will accurately measure harmonic distortion at any or all frequencies between 20 and 20,000 CPS. Distortion is read on panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Full scale voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio is measured on a separate meter scale calibrated in db. Features high input impedance (300,000 ohms) and 1% precision resistors in the VTVM voltage divider circuit for excellent sensitivity and accuracy. High quality components insure years of dependable service. Complete instructions provided for easy assembly and operation. Shpg. Wt. 13 lbs.

New Styling - New Features...

HEATHKIT TX-1 **$229.50**

Complete Versatility for Top-Notch Amateur Communications

★ NEWLY DESIGNED VFO—ROTATING SLIDE RULE DIAL
★ MODERN STYLING—PROVISION FOR SSB ADAPTER

"APACHE" HAM TRANSMITTER KIT

Fresh out of the Heath Company laboratories, the brand-new "Apache" model TX-1 ham transmitter features modern styling and the latest in circuitry for extra fine performance. The "Apache" is a high quality transmitter operating with a 150 watt phone input and 180 watt CW input. In addition to CW and phone operation, built-in switch selected circuitry provides for single-sideband transmission through the use of a plug-in external adapter. These SSB adapters will be available in the near future. A compact, stable and completely redesigned VFO provides low drift frequency control necessary for SSB transmission. A slide rule type illuminated rotating VFO dial with vernier tuning provides ample bandspread and precise frequency settings. The bandswitch allows quick selection of the amateur bands on 80, 40, 20, 15 and 10 meters. (11M with crystal control). This unit also has adjustable low level speech clipping and a low distortion modulator stage employing two of the new 6CA7/EL-34 tubes in push-pull class AB operation. Time sequence keying is provided for "chirpless" break-in CW operation. The final amplifier is completely shielded for greater TVI protection and transmitter stability. Die-cast aluminum knobs and front panel escutcheons add to the attractive styling of the transmitter. Pi network output coupling matches antenna impedances between 50 and 72 ohms. Shpg. Wt. 115 lbs.

$50.00 deposit required on C.O.D. orders. Shipped motor freight unless otherwise specified.

HEATHKIT DX-20 **$35.95**

An Ideal Code Transmitter

HEATHKIT DX-100 **$189.50**

You'll be Proud to Own This Outstanding Performer

HEATHKIT DX-40 **$64.95**

Phone & CW Facilities at Low Cost

DX-20 CW TRANSMITTER KIT

Designed especially for CW work, the DX-20 features high efficiency at low cost. An ideal rig for the novice or advanced-class CW operator. Plate power input is 50 watts, and covers 80, 40, 20, 15, 11 and 10 meters with single knob bandswitching. Features a single 6DQ6A tube in the final amplifier stage and a 6CL6 as a crystal oscillator. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long service life. Complete shielding to minimize TVI. Removable metal pull-out plug on left end of cabinet provides access for crystal changing. Very easy to build with complete instructions supplied. Shpg. Wt. 19 lbs.

DX-100 PHONE AND CW TRANSMITTER KIT

Well known for its high quality and fine performance the DX-100 features a built-in VFO, modulator, and power supply, complete shielding to minimize TVI, and a pi network coupling to match impedances from 50 to 600 ohms. RF output is in excess of 100 watts on phone and 120 watts on CW, for clean strong signals on all ham bands from 10 to 160 meters. Single knob bandswitching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as potted transformers, silver-plated or solid coin silver switch terminals, aluminum-heat dissipating caps on the final tubes, copper plated chassis, etc. Shpg. Wt. 107 lbs.

$50.00 deposit required on C.O.D. orders. Shipped motor freight unless otherwise specified.

DX-40 PHONE AND CW TRANSMITTER KIT

An outstanding buy in its power class the DX-40 provides both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 75 watt plate power input on CW, or controlled carrier modulation peaks up to 60 watts for phone operation. Modulator and power supplies are built in and single-knob bandswitching is combined with the pi network output circuit for complete operating convenience. Complete shielding to minimize TVI. Provision is made for three crystals. A four-position switch selects any of the three crystals or a jack for external VFO. Crystal sockets are reached through access door in rear of cabinet. High quality D'Arsonval movement panel meter. Shpg. Wt. 25 lbs.

For Real Ham Enjoyment

HEATHKIT

"MOHAWK" HAM RECEIVER KIT

Here is a ham receiver that any radio operator would be proud to own. The "Mohawk" has all the functions required for high quality communications with clear, rock-steady reception on all bands. This 15-tube receiver features double conversion with IF's at 1682 kc and 50 kc and covers all of the amateur frequencies from 160 through 10 meters on seven bands with an extra band calibrated to cover 6 and 2 meters using a converter. Receiver accommodations are provided for these converters which will be available in Heathkits soon. The "Mohawk" is specially designed for single-sideband reception with crystal controlled oscillators for upper and lower sideband selection. A completely preassembled, wired and aligned front end coil assembly assures ease of construction and top performance of the finished unit. Other features include five selectivity positions from 5 kc to 500 CPS, bridged T-notch filter for maximum heterodyne rejection, and a built-in 100 kc crystal calibrator. The set provides a 10 db signal-to-noise ratio at less than 1 microvolt input. Front panel features S meter, separate RF, IF and AF gain controls, T-notch tuning, T-notch depth, ANL, AVC, BFO, bandswitch, tuning, antenna trimmer, calibrate set, calibrate on, CW-SSB-AM, receive-standby, upper-lower sideband, selectivity, phone jack and a wide band rotating slide rule type vernier tuning dial with easy to read calibrations. Shpg. Wt. 90 lbs.

$50.00 required on C.O.D. orders. Shipped motor freight unless otherwise specified.

HEATHKIT RX-1 **$274.95**

Now in Kit Form a Top Quality Ham Band Receiver

★ PREWIRED AND ALIGNED FRONT END COIL ASSEMBLY.
★ CRYSTAL CONTROLLED OSCILLATORS FOR DRIFT-FREE RECEPTION.

HEATHKIT B-1 **$8.95**

Get Proper Match Between Transmitter and Antenna

BALUN COIL KIT

Unbalanced coax lines used on the most modern transmitters can be matched to balance lines of either 75 or 300 ohms impedance by using the model B-1 Balun Coil Kit. Can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will handle power inputs up to 200 watts. Cabinet size is 10" square by 5" D. and may be located any distance from the transmitter or antenna. A protective cover is supplied to prevent damage in outdoor installations. Shpg. Wt. 4 lbs.

HEATHKIT AM-2 **$15.95**

Measure Standing Wave Ratio

REFLECTED POWER METER KIT

The match of your antenna transmission system can be checked by measuring the forward and reflected power or standing wave ratio from 1:1 to 6:1 with this fine unit. Designed to handle a peak power of well over 1 kilowatt of energy the AM-2 may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Cabinet size is 7⅜" x 4⅛" x 4⅝". Shpg. Wt. 3 lbs.

HEATHKIT VX-1 **$23.95**

Eliminates Hand Switching

ELECTRONIC VOICE CONTROL KIT

This unique device allows you to switch from receiver to transmitter merely by talking into your microphone . . . you get the advantage of "telephone-type conversation" as in single sideband but with regular AM transmission. The unit is adjustable to all conditions by sensitivity controls provided. A variable time delay control changes the "hold" time. Provision is made for receiver and speaker connections and also for a 117 volt antenna relay. Built-in power supply. Complete instructions provided. Shpg. Wt. 5 lbs.

HEATHKIT PM-1 **$14.95**

Quick Check of Transmitter Operation

RF POWER METER KIT

This self contained unit requires no power for operation. You simply place it close to the transmitter antenna to sample the RF field which is then indicated on the panel meter. Operates with any transmitter having an output frequency between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS full scale, and a special control on the panel allows for further adjustment of the sensitivity. Measures 3¾" W. x 6¼" L. x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • **Benton Harbor 15, Mich.**

Choose from a wide variety of Heathkit

DUAL-CHASSIS 20 WATT HI-FI AMPLIFIER KIT

Model W3-AM
(Shpg. Wt. 29 lbs.)
$49.75

12" UTILITY SPEAKER

Model 401-6
(Shpg. Wt. 7 lbs.)
$7.50

ALL-BAND RADIO KIT

Model AR-3
(Shpg. Wt. 12 lbs.)
$29.95
(less cabinet)

CRYSTAL RADIO KIT

Model CR-1
(Shpg. Wt. 3 lbs.)
$7.95

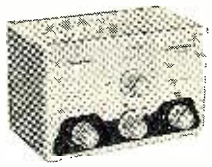
BROADCAST BAND RADIO KIT

Model BR-2
(Shpg. Wt. 10 lbs.)
$18.95
(less cabinet)

ELECTRONIC CROSSOVER KIT

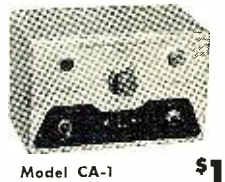
Model XO-1
(Shpg. Wt. 6 lbs.)
$18.95

"Q" MULTIPLIER KIT



Model QF-1
(Shpg. Wt. 3 lbs.)
$9.95

"AUTOMATIC" CONELRAD ALARM KIT



Model CA-1
(Shpg. Wt. 4 lbs.)
$13.95

GRID DIP METER KIT

Model GD-1B
(Shpg. Wt. 4 lbs.)
$21.95

VIBRATOR POWER SUPPLY KIT

6 volt Model VP-1-6
12 volt Model VP-1-12
(Shpg. Wt. 4 lbs.)
$7.95 ea.

VARIABLE FREQUENCY OSCILLATOR KIT

Model VF-1
(Shpg. Wt. 7 lbs.)
$19.50

PROFESSIONAL RADIATION COUNTER KIT

Model RC-1
(Shpg. Wt. 8 lbs.)
$79.95

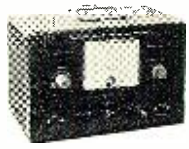
ISOLATION TRANSFORMER KIT

Model IT-1
(Shpg. Wt. 9 lbs.)
$16.50

ELECTRONIC SWITCH KIT

Model S-3
(Shpg. Wt. 8 lbs.)
$21.95

REGULATED POWER SUPPLY KIT



Model PS-3
(Shpg. Wt. 17 lbs.)
$35.50

VOLTAGE CALIBRATOR KIT

Model VC-3
(Shpg. Wt. 4 lbs.)
$12.50

DIRECT-READING CAPACITY METER KIT

Model CM-1
(Shpg. Wt. 7 lbs.)
$29.50

TUBE CHECKER KIT

Model TC-2
(Shpg. Wt. 12 lbs.)
$29.50

EASY TIME PAYMENTS

AVAILABLE FOR YOUR CONVENIENCE . . .

Any order totaling $90 or more can be paid for in small monthly payments (send for complete details).

RESISTANCE SUBSTITUTION BOX KIT

Model RS-1
(Shpg. Wt. 2 lbs.)
$5.50

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Model CS-1
(Shpg. Wt. 2 lbs.)
$5.50

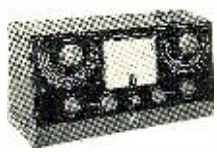
CATHODE RAY TUBE CHECKER KIT

Model CC-1
(Shpg. Wt. 10 lbs.)
$24.95

LABORATORY RF GENERATOR KIT

Model LG-1
(Shpg. Wt. 16 lbs.)
$48.95

"Q" METER KIT



Model QM-1
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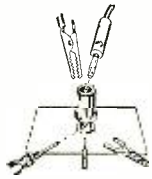

Model 362
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MODEL IA-1
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Scope Demodulator Probe Kit

Model 337-C
(Shpg. Wt. 1 lb.)

$3.50

Low Capacity Probe Kit
Model 342
(Shpg. Wt. 1 lb.)

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30,000 Volt DC HV
Probe Kit No. 336
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Etched Circuit RF
Probe Kit No. 309-C
Shpg. Wt. 1 lb. **$3.50**

Peak-to-peak Voltage
Probe Kit No. 338-C
Shpg. Wt. 2 lbs. **$5.50**

ENLARGER TIMER KIT

Model ET-1
(Shpg. Wt. 3 lbs.)

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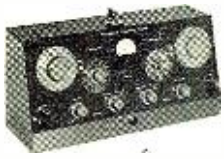

Model IB-2A
(Shpg. Wt. 12 lbs.)

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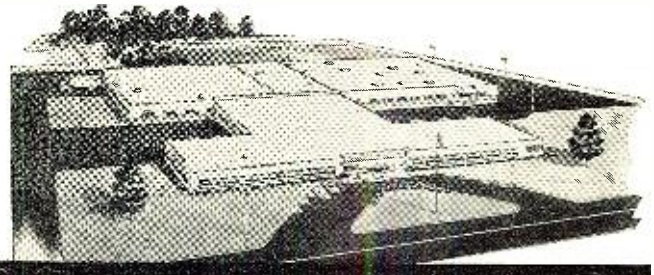

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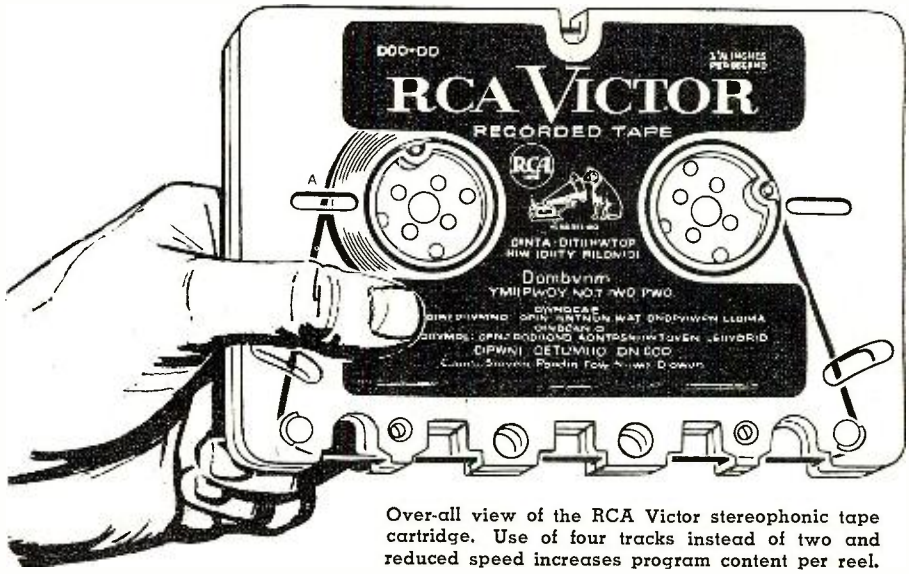

Over-all view of the RCA Victor stereophonic tape cartridge. Use of four tracks instead of two and reduced speed increases program content per reel.

RCA's 4-Track Stereo Cartridge

Slip-in unit eliminates threading and rewinding of tape, provides one-hour stereo program at 3¾ ips.

LONG rumored in the industry and recently reported in the "laboratory" stage, *RCA* has startled the audio world by announcing that its 4-track stereo tapes are available *on the market* in special plastic cartridges which eliminate tape handling and rewinding. The cartridge provides up to an hour's uninterrupted listening at a speed 3¾ ips.

Using a quarter-inch tape, the size of the cartridge is kept to a mere 7" x 5" x ½".

In order to handle the new cartridges, the company has announced two tape machines (available in October) which will accommodate the tape packages in both recording and playback modes. For home recording, the company plans to issue cartridges with blank tapes.

Aside from convenience in playing and storing tapes, the new cartridges represent an economic advantage since *RCA* is listing them at from $4.95 (22 min.) to $9.95 (60 min.) as contrasted to regular stereo tape tickets of from $8.95 to $18.95.

By the end of June, the company had 32 releases on the market—representing both classical and pop selections from the *RCA Victor* catalogue.

The new 4-track tapes in cartridge form require specially designed machines on which to play them. In operation, the cartridge is inserted onto the deck of the tape machine where it starts automatically. With the completely automatic cartridge machine, no further action is required of the user. Special windows in the cartridge permit visual monitoring of the tape remaining on the hub.

Although still too early to evaluate the impact of this new development in stereo tape packaging, the fact that *RCA* is making the cartridge plans available to other manufacturers indicates that the firm feels it has a better-than-even chance of setting the industry standard for tape distribution.

Another factor in this development is the possibility of gaining new tape adherents because putting on a tape cartridge is less involved than slipping a disc on a conventional record player. There have been some complaints in the past from non-technical users of tape machines that the threading, loading, rewinding, etc. involved in handling the tape reels was a decided deterrent to complete enjoyment of the medium. This objection is, of course, overcome by the cartridge packaging.

To date there have been no indications that any sort of adapters will be forthcoming to permit the conversion of existing machines to handle cartridges.

Ampex has recently anounced that they are releasing conversion kits so that owners of their stereo tape machines can convert them to handle 4-track stereo tapes (See "Sound on Tape," page 104 of this issue).

Of course those who convert their *Ampex* machines can enjoy the program from the cartridges by rewinding the tapes onto standard reels which will fit their machines. —30—

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RN-20

Service Association of the Month

NATIONAL ALLIANCE OF TV & ELECTRONIC SERVICE ASS'NS

IF YOU WANT to avoid controversy, all you have to do is show little interest in matters of concern, sidestep issues, and avoid taking stands. Now in its tenth year, NATESA has often been the center of controversy. It is also true that it has spoken out boldly on issues of interest to the service industry, taken many stands, and been militantly active.

Although the organization was incorporated as a non-profit group in the District of Columbia in 1949, this formal step was preceded by some years of preliminary planning and research on the part of Frank J. Moch, present executive director, and other founders. In response to telegrams sent to about 50 key people considered active in service-association work, men representing eight local associations turned up at the organizing meeting, along with representatives of the national government and other phases of the electronics industry. By contrast, the National Alliance of Television & Electronic Service Associations recently reported 98 affiliated local units, with the number probably over the 100 mark by the time this appears in print. In addition, there are 2000 unattached individual members in areas where no local affiliate exists. Members are located everywhere in this nation and outside of it.

NATESA came into being because it was felt that, considering the scope and importance of TV servicing on a nation-wide scale, many of the industry's problems could best be dealt with on a broad, nation-wide level. Actually this organization, which is headquartered at 5906 South Troy Street, Chicago 29, Ill., has never attained the unanimous acceptance, as a national instrument, it has sought to achieve from all service-industry groups. There are many local groups that, for one reason or another, prefer not to identify themselves with the National Alliance. Of these, some are bitterly opposed to NATESA; others have cooperated in certain areas despite their wish to avoid specific identification. In spite of this lack of universal acceptance, no other parallel national group has been developed to the point where it has been able to challenge NATESA seriously in the attempt to provide a national instrument that may speak for service with one voice.

To keep step with a changing industry and to promote growth, NATESA's structure has undergone many alterations since it was first established. Originally there was a single vice-president, for example. Now there are four regional divisions to cover the country, each with its own vice-president and secretary. Each division is divided into zones headed by governors. Each of the zones, in turn, consists of state groups headed by state chairmen. Under these are the local affiliated associations, each with its own director for the NATESA board.

The executive council comprises the executive director, the president, the four divisional vice-presidents and their four secretaries, the secretary general, and the treasurer. This group, actually responsible for operating NATESA activities, is answerable to the directorate, which consists of one member from each NATESA affiliate. Every officer is in the service business.

Voting used to be on the basis of one vote for each affiliate. With growth, considerable variation began to develop in the sizes of the local member organizations, so a system of proportional representation was worked out. An affiliate's voting power is now based on its paid membership. However, to avoid having small groups get lost in the shuffle, no association casts less than 10 votes. No affiliate may hold more than one national office. The presidency cannot be held for more than one year by any individual and this office cannot be filled consecutively from one affiliate.

A directors' meeting takes place every spring in one city or another that has a local affiliate. In late summer or early fall, there is a general convention held in the headquarters city, Chicago. This year it will run at the Congress Hotel from August 21 to 24.

Initially NATESA consisted of independently organized local groups that banded together. More recently there have been many "home grown" affiliates that have resulted from the national body's organizing activity. Available to all interested parties on request to the national headquarters is extensive literature on organizing associations. Taking firm stands on a wide range of service-industry issues, NATESA has presented its views before a number of national and state governmental bodies.

Incumbent officers include Russell Harmon (president), Mac Metoyer (secy. general), Nelson Burns (treas.), and Albert Sanders (educational director). Divisional officers and others are too numerous to list. The official publication is the monthly magazine, "NATESA Scope." —30—

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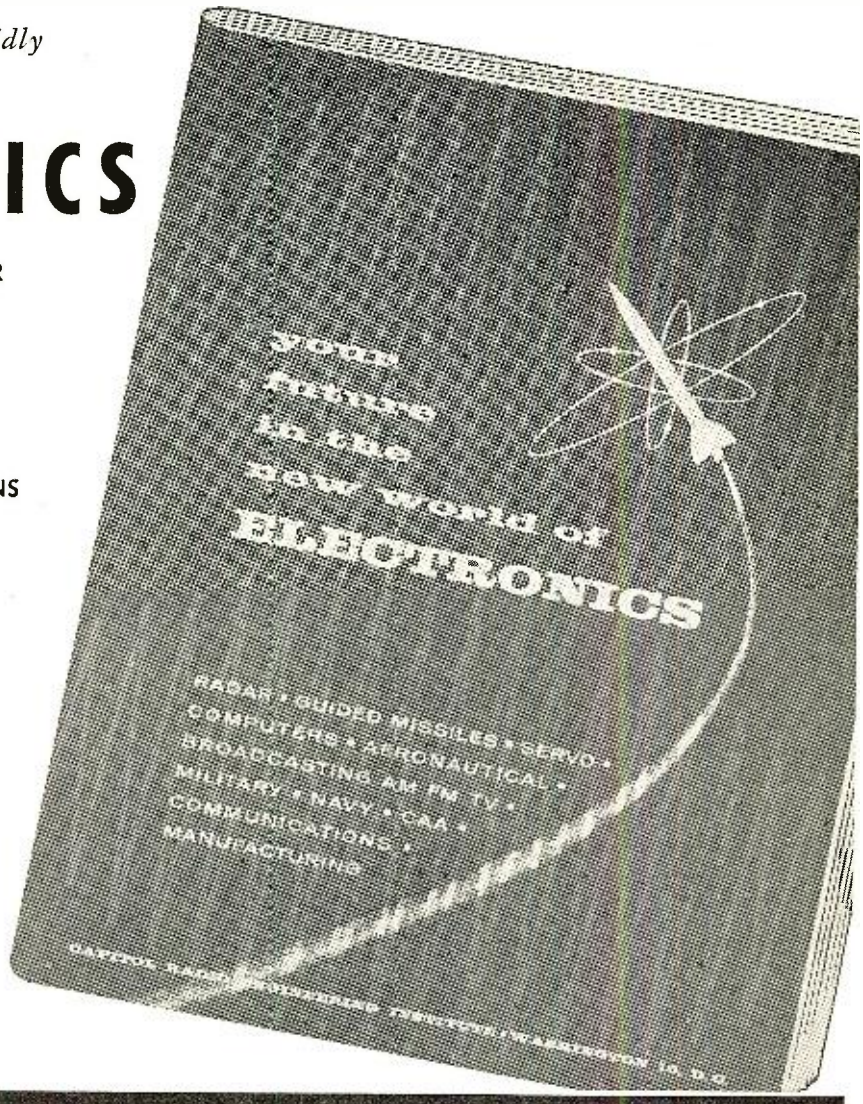

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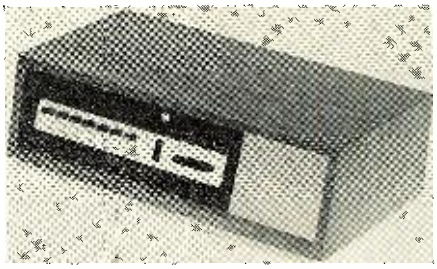
Hi-Fi-Audio Product Review

NEW INTERCOM LINE

Fisher Berkeley Corporation, 4224 Holden St., Emeryville 8, Calif. has recently added a new ultra-flexible,



walnut-cabineted series to its line of "Ektacom" intercoms.

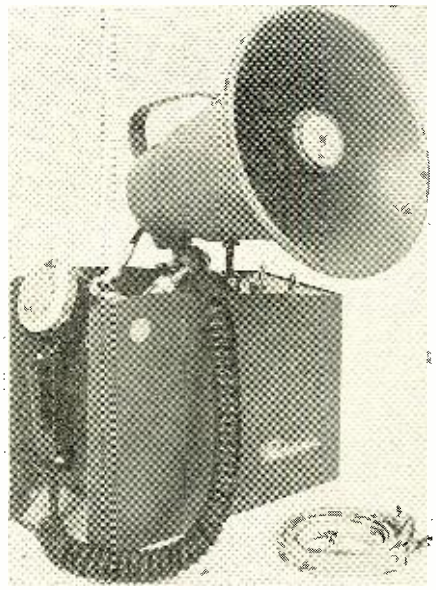
Featuring the new "Auto-Mute" circuit (which completely silences the units when not in use), the "W" series uses instrument-quality components, heavy-duty speakers, and balanced 45-ohm lines.

A complete group of six- and twelve-station masters, various remote speaker units, plus booster amplifiers for paging, and other accessories are available.

Catalogue 583, available from the manufacturer, contains complete information on the new line.

RCA'S "PORTAHORN"

The Radiomarine Sales Department of *Radio Corporation of America* has introduced a lightweight transistorized



instrument which is designed to serve as a fog warning device, as a megaphone, or as a p.a. amplifier.

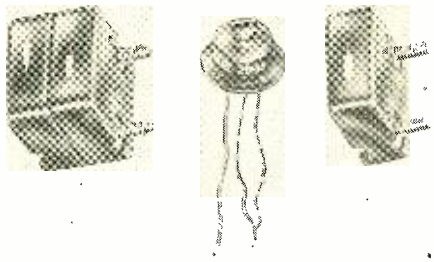
Tradenamed the "Portahorn," this loudspeaker-equipped device can also be used with radio equipment, tape recorders, and record players. It can be used aboard any sized craft and provides voice communications over a distance of more than a mile.

The unit weighs only 13½ pounds and consists of a completely transistorized preamplifier, power amplifier, oscillator, and relay. Eight *RCA* transistors are used in the circuit. Two 6-volt batteries operate the device.

LOW-POWER ERASE HEAD

Michigan Magnetics, Inc. of Vermontville, Mich. has announced the availability of a new low-power erase head which has been especially designed for use with transistor circuitry.

The Type "S" provides 55 db erasure with but .5 va. current. The physical structure is extremely thin and designed to permit ganging to obtain



two-track and four-track erasure. Size of the unit is compared with a transistor in the photo. Alignment of ganged units is obtained through a unique ball and ball seat arrangement.

Complete specifications in any desired configuration are available.

NEW NORELCO CARTRIDGE

The High Fidelity Products Division of *North American, Philips Company, Inc.,* Hicksville, N. Y. is using nonmetallic ferrites as permanent magnets in its "Magneto-Dynamic" phono cartridges.

The cartridge operates according to a new principle of transducer design, with the magnet in motion and the coil stationary. The heart of this new principle is the armature. The armature is a thin cylindrical rod $\frac{1}{32}$" in diameter and approximately ½" long, made of "Ferroxdure," a special high-coercivity, hard ferrite material developed by *Philips* of the Netherlands.

Dynamic mass at the stylus is 2.8 milligrams and vertical tracking force is 5 grams. The "Magneto-Dynamic" cartridge comes complete with a 1-mil diamond stylus.

NEW NEEDLE PACKAGE

Pfanstiehl Chemical Corp. of Waukegan, Ill. is now merchandising its line of diamond phonograph needles in a newly designed transparent package.

The new square box makes the entire needle fully visible against a background of colored polyurethane foam. A different colored background is used for each type of needle to provide instant recognition. The cover of the box is gold with black printing.

Full instructions and re-ordering in-

formation are carried on the bottom of each package.

P.A. BOOSTER AMPLIFIER

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has released a new unit in its "Knight" line of audio equipment.

The new item is a 60-watt p.a. power booster which has been designed to

be used with any conventional p.a. amplifier. The KN-3061 will provide 60 watts of added power output with only .4 volt input.

The amplifier has an input level control for adjusting volume to meet specific requirements as well as to prevent overloading. A unique feature of this power booster is its trumpet voice-coil "protector" switch. Speaker output taps are provided for matching 4, 8, 16, 250, and 500 ohms as well as 70.7-volt lines. There is an output jack included which permits convenient tape recording of material being fed through the p.a. system.

Frequency response is ± 2 db from 20 to 20,000 cps at full 60 watt output. Hum level is −71 db.

MATCHED AMPLIFIER-TUNER

David Bogen Company, Paramus, N. J. is now marketing the AC10 amplifier and matching TV100 AM-FM tuner, the first in the company's new line of "Challenger" budget-priced high-fidelity components.

Housed in a black metal cabinet with a contrasting black and gold control panel, the AC10 offers separate bass and treble controls, the firm's loudness contour selector, and instant selection of popular tape and record equalization positions. The tuner offers a.f.c., limiter and discriminator cir-

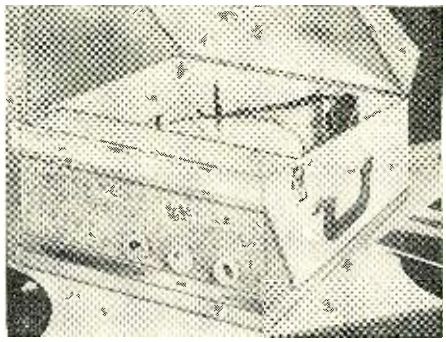
cuitry, a matched pair of crystal diodes to eliminate hum and distortion, and a.v.c.

Write the manufacturer for full specs on these new units.

STEREO PHONOGRAPHS

Sonic Industries, 19 Wilbur St., Lynbrook, N. Y. has previewed a line of seven stereophonic phonographs—four portables and three console models.

The Model 760 shown in the photo is styled in a two-tone driftwood tan and white leather-grained Pyroxyline



coated finish. Dual-stereo, printed-circuit amplifiers produce a total of 10 watts output over the range from 50 to 10,000 cps. The unit may be instantly connected to the extension stereo speaker which is available at slight extra cost. Stereo balance, volume, and tone controls are incorporated.

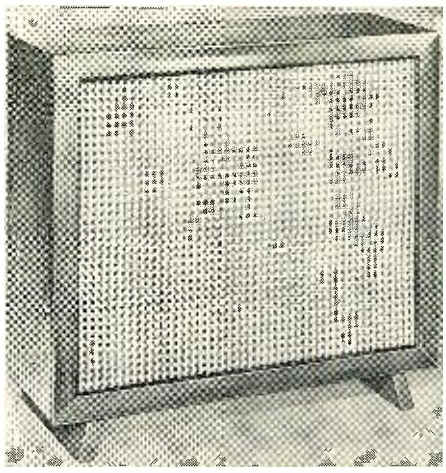
The unit includes a four-speed stereo record changer and 6″ coax speaker system. This is the least expensive model in the line.

The manufacturer will supply full details on this phonograph and/or the other units in the line on request.

GRANCO SPEAKER SYSTEM

Granco Products Inc., 36-07 20th Ave., Long Island City 5, N. Y. has recently introduced a 3-way speaker system to the trade.

The Model S-30 features a 12″ woofer, 4″ mid-range, and 4″ tweeter with



a crossover network. The speakers are mounted in a specially designed bass-reflex enclosure which is compactly styled in a choice of walnut, mahogany, or oak.

The enclosure measures 24″ wide, 11″ deep, and 21″ high. The system is designed to be used with a tuner-amplifier or as an external speaker for existing hi-fi setups.

STEREO CONTROLS FOR HI-FI

Clarostat Manufacturing Company, Inc. of Dover, N. H. has announced the availability of a line of dual concentrics developed especially for stereo applications.

The two sections of such controls can be operated either simultaneously or, by pulling out the rear shaft ⅛″, individually. The sections are operated individually while adjusting for desired balance between the two amplifier channels, then, by pushing in the shaft, the two sections are locked together for simultaneous and balanced operation.

THREE-WAY SYSTEM

A three-way high-fidelity speaker system, custom-made by *Goodmans* of England, has just been introduced by *Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N. Y.

The system is designed to be installed in a bass-reflex enclosure and provides coverage of the range from 30 to 16,000 cps (8 db down at 20,000 cps). The system includes *Lafayette's LC* crossover network, with brilliance and presence controls, working into an impedance of 16 ohms.

The three speakers in the system, the 12″ SK-102 woofer, SK-103 mid-range, and SK-104 tweeter, are available individually if desired.

AUDIO CATALOGUES

WHAT'S YOUR "TAPE TYPE"

Minnesota Mining and Manufacturing Co., 900 Bush St., St. Paul 6, Minn. is now offering a helpful guide to selecting the right magnetic tape for the user's specific recording needs.

Entitled "Which Tape Type Are You?" the publication illustrates the outstanding features of each of the eight popular "Scotch" brand magnetic tapes with a "one man rogue's gallery" series of photos.

In addition, the 16-page accordion type folder provides descriptions of each of the tapes including such things as playing time, special features, backing thickness, and applications. Accessory items are described and illustrated and a convenient playing time chart included.

For a free copy, address your requests to Dept. A8-89 of the company.

SPEAKER DIMENSIONS

Oxford Electric Corporation, 3911 S. Michigan Ave., Chicago 15, Ill. has issued a 28-page booklet entitled "Dimensional Data of *Oxford* Speakers."

Presented in a blue and yellow format with durable cover, the booklet has been designed to be of service to manufacturers, jobbers, and technicians who use the company's line of speakers. Complete information is included on a variety of units ranging in size from 2½″ round to 6″ x 9″ elliptical and 2½″ x 10″ rectangular models. —30—

Don't Blame "Competition"

(*Continued from page 54*)

service business that is being done in his area to determine what percentage of it he is getting. This information is also important in helping him to plan on how he can increase his percentage of this market.

In a recent issue of its monthly bulletin, under the title "The Radio-TV Service Business is Big Business," the *Radio Parts Company* of Arizona gave its customers the following formula for determining the dollar volume of their individual service markets:

"Take the total population of your community. Divide this total by 3½ (the average number of persons per family). This gives you the number of families in your area. The average family has at least one radio and—in TV areas—at least one TV receiver, too. This is your market.

"Statistics show an average family spends $9.07 for radio repairs yearly. Multiply that amount by the number of families. If you're in a TV area multiply by $34.70 instead. That's the amount spent by an average family every year for both radio and TV service.

"The result is your potential market."

There should never be a slump season for any electronic service business. Every month throughout the year, some type of electronic entertainment device is in its peak season of use. Timely promotions and the willingness to service any type of electronic product will level out a shop's volume of business and provide a uniform income every month.

A thorough knowledge of the local or dealer's trading-area market is vitally important in directing a business toward steady growth. A dealer's market may be the entire community in a small town or just a small section of a metropolitan city. Irrespective of its location, the dealer should be thoroughly familiar with the people and the electronic products they are using as a guide to promoting and developing his business.

A service dealer must be constantly alert for ideas that will help him break away from the conventional patterns used for promoting service businesses. This is a dynamic, changing era. People welcome new ideas or old ideas presented with a new slant. By keeping an idea file, an aggressive dealer can find many inexpensive ways to keep set-owner attention focused on his business and the services he can render.

There will always be lots of competition. But it will never seriously affect the service dealer who knows his market, directs his business on the basis of pre-conceived plans; and drives aggressively to capture the maximum volume in the market he has prescribed for himself. —30—

Superior's New Model TD-55

EMISSION TYPE

UBE ESTER

For the Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
For the Professional Serviceman, who needs an extra Tube Tester for outside calls.
For the busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket

It is impossible to insert the tube in the wrong socket when using the new Model TD-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system

The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin or even the "top-cap."

Checks for shorts and leakages between all elements

The Model TD-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification

One of the most important improvements, we believe, is the fact that the 4 position fast action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TD-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

Superior's New Model TW-11

STANDARD PROFESSIONAL

TUBE TESTER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novels, Sub-minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES—Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

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Superior's New Model 82

RAPID TESTER

The Very Best Value in Multi-Socket Tube Testers!

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. We don't expect it to completely replace conventional testers but if you want to try this new type of tester, you can do no better than mail the coupon on facing page. Don't let the low price mislead you! We claim Model 82 will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine-before-you-buy policy.

Primarily, the difference between the conventional tube tester and the multi-socket type is that in the latter, the use of an added number of specific sockets (for example, in Model 82 the noval is duplicated eight times) permits elimination of element switches thus reducing testing time and possibility of incorrect switch readings. To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch—THAT'S ALL! Read quality on meter. Inter-element leakage, if any indicates automatically.

FEATURES:

- ★ Dual Scale meter permits testing of low current tubes.
- ★ 7 and 9 pin straighteners mounted on panel.
- ★ All sections of multi-element tubes tested simultaneously.
- ★ Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence.
- ★ Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

$36.50 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

- √ Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- √ Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- √ Model 77 uses new improved SICO printed circuitry.
- √ Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- √ Model 77 uses a selenium-rectifier power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- √ Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- √ Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER:

The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER:

Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER:

Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

Specifications

• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS:** —10 db to + 18 db. + 10 db to + 38 db. + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER** — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only.....

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The Most Versatile All-Purpose Multi-Range Tester Ever Designed

Superior's New Model 79

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WITH NEW 6" FULL-VIEW METER

A Combination **VOLT-OHM MILLIAMMETER.**

Plus **CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.**

Also Tests

SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES.

Model 79 completely wired and calibrated with test leads and portable carrying case sells for only $38.50. Positively *no* extras to buy.

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

Specifications

- √ **D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500.
- √ **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000.
- √ **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
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- √ **CAPACITY:** .001 to 1 Mfd. 1 to 50 Mfd.
- √ **REACTANCE:** 50 to 2,500 Ohms. 2,500 Ohms to 2.5 Megohms.
- √ **INDUCTANCE:** .15 to 7 Henries. 7 to 7,000 Henries.
- √ **DECIBELS:** —6 to +18. +14 to +38. +34 to +58.

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

- √ **All Electrolytic Condensers** from 1 Mfd. to 1000 Mfd.
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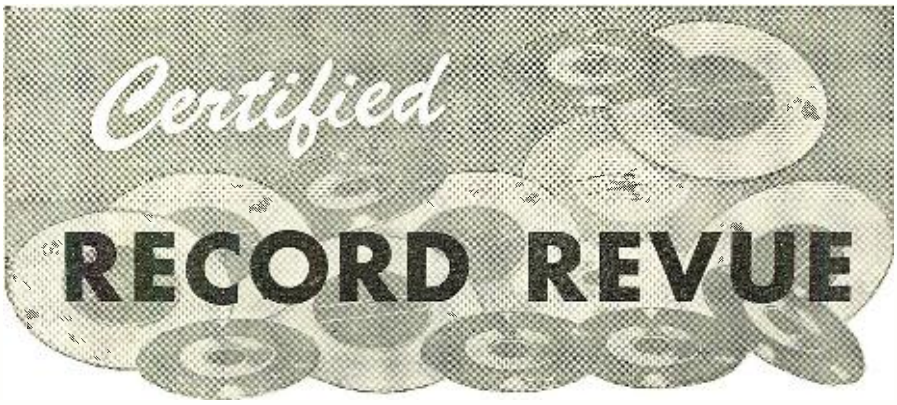


By BERT WHYTE

BY THE time you read this the stereo disc campaign will have started with a bang! The target date has been firming up all the time and unless something really goes awry, this column should reach you in the second month (August) of the stereo disc era. By now some of the die-hards have begun to accept the inevitability of the stereo disc and the band-wagon is slowly gaining momentum. The opposition among record dealers to the problems of "double inventory" is simmering down and the "doubting Thomases" among the hi-fi shops are belatedly placing orders for all the new stereo disc equipment that is beginning to appear on the market.

It has slowly dawned on many people that the stereo disc isn't just another hi-fi innovation or advance, but the start of a fabulous new business. The public themselves have initiated this idea. Many consumers are walking into shops and proclaiming that they've already got "a hi-fi" but they hear that stereo is better and they want to find out all about it. There is no use trying to argue with these folks that stereo is just the ultimate form of hi-fi and, in fact, a prudent dealer will be better off not trying to fight this idea. And so . . . rather incredibly . . . the hi-fi market has a new two-edged approach. One is the thousands of old customers already well established with component hi-fi equipment who will be eager to switch to stereo and the other a whole new group of people who consider stereo a new and separate entity quite "superior" to hi-fi. There is, however, a warning implicit in the attitude of these people. Thinking the way they do, they can be easy targets for so-called "packaged stereo" consoles and items of similar ilk. And let's face the hard fact that these units, because of the stereo facilities, will undoubtedly sound better than anything to which these people have previously been exposed.

You and I know there is a lot more to good stereo sound than two speakers, two amplifiers, and a stereo pickup. To obtain really good stereo will still require the use of quality components, properly matched and properly installed, with the acoustics of the room in which the system is to be installed a matter of no little concern. As in "normal" hi-fi, a lot of people are going to be deluded into thinking they have the real McCoy in their stereo setup. This can ultimately do nothing but harm to the whole stereo picture.

Yes, the era of the stereo disc and the coming of low-cost, 4-channel stereo tapes can mean a vastly expanded market but it would appear that some hard selling is ahead to combat those who would sublimate integrity in pushing stereo as an "ultimate sound," irrespective of the form the quality takes and the cost of equipment in its lowest common denominator.

STRAVINSKY
PETROUCHKA
(COMPLETE BALLET)
L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London LL3018. Price $4.98.

Ernest Ansermet has always been associated with this score and his recording of it many years ago for *London* (then known as *Decca ffrr*) was regarded as a near definitive performance and the sound was for a very long time an extraordinary hi-fi spectacular and considered a model of the best in British techniques.

This is an entirely new recording redone for stereo disc of course, but offering a bonus in that this is done in the original edition and is the "complete ballet." One hearing of this new disc is enough to convince you that *London* has not rested on its recording laurels. This is a phenomenal sound they produce. It has superb balance, with every instrument completely articulate and an over-all cleanness that is astonishing. There is really wide range in frequency and dynamics here and the impact and clean transients of the percussion are stunning. Perhaps the most laudable feat on this disc is that in spite of the great orchestral detail and the immense power generated, the acoustics are so perfectly handled that there is never any sensation of strain and all seems imbued with a naturalness that is uncanny.

Ansermet's performance is as penetrating and perceptive as his earlier one and, although the years have slowed his tempi somewhat, if anything the reading gains from this and each section seems more expositional. There are people who won't like that, of course, arguing the case for flow and continuity. I think Ansermet bridges the various sections quite satisfactorily and yet each section is developed to the ultimate point of effectiveness.

I could go on for another page on the sonic delights of this recording and when I think of what the stereo must sound like I positively drool! There are other good recordings of "Petrouchka," but for me this is the brightest amalgam of performance and sound. Try it and see for yourself!

BERLIOZ
SYMPHONIE FANTASTIQUE
Paris Conservatoire Orchestra conducted by Ataulfo Argenta. London LL3016. Price $4.98.

This seems to be a month of notable recordings from *London*. Here we have one of the last recordings of the brilliant Argenta, made just before his untimely and fatal accident. This is not a "traditional" reading of the Berlioz work but abounds in color and in phrasing and expression typical of the conductor's personality.

Purists won't like this, but for me it is one of the most exciting performances I have ever heard. The first "quiet" movements Argenta takes a little faster than usual. In the fire and tempest of the last movements he really sets a fast pace. The musicians are equal to Argenta's urgings, however, and the result is startling in its furious assertiveness. The sound is exceptionally bright and *London* really takes the wraps off the percussion in the "Witches Sabbath" and "March to the Gallows." The tympani explode with great impact and the bells set up a mighty brazen clangor, while the brass growl ominously with strings and woodwinds in the chilling measures of the "Dies Irae." An unorthodox but very thrilling performance and worth a listen!

BRAHMS
SYMPHONY #3 IN F MAJOR
Vienna Philharmonic Orchestra conducted by Rafael Kubelik. London LL3010. Price $4.98.

If I'm not mistaken, this recording leaves only the Brahms "1st Symphony" to complete *London's* projected recording of all the Brahms symphonies with Kubelik. The series has been quite notable thus far in terms of superb sound and stimulating performances. This present recording carries on in that tradition. This is a very big, very natural sounding Brahms "3rd." All orchestral elements are in fine balance and every instrument is completely articulate with gorgeous string tone from the orchestra and in the famous horn passage. Dynamics are most expressive and wide ranging.

Kubelik's reading is vigorous and full. He is, however, never too heavy-handed and for the most part the essential lyricism shines through. His tempi are a little faster than most, but this keeps the weight of the huge orchestra from becoming ponderous. Certainly he affords a fine insight and understanding of the score and his version must be near the top of the list of available recordings. From the audio viewpoint it is perhaps the most "concert hall' sounding of all, although not the most consciously "hi-fi" recording in the catalogue. This should have broad sales appeal.

HANDEL-HARTY
WATER MUSIC SUITE
HANDEL
ROYAL FIREWORKS MUSIC
London Symphony Orchestra conducted by Antal Dorati. Mercury MG50158. Price $4.98.

There have been many recordings of the "Water Music" and many of them have been quite successful. None of them, however, can quite come up to the over-all brilliance of this latest effort by Dorati and the London Symphony Orchestra. Dorati has managed here what is very difficult to obtain either in a concert performance or a recording . . . that fine, hair-splitting balance between stately grace and lyricism on one hand and the festive, joyful nature of the work on the other. Dorati's reading is pure excitement . . . it has sweep and just the proper amount of grandeur. Rarely has the famous "hornpipe" section which ends the suite sounded so ebulliently alive and sparkling.

The "Fireworks" music is treated in a somewhat similar fashion, but with a little heavier concentration on the rhythmic aspects of the score. No little part of the success of this recording must be ascribed to the London Symphony. I suppose with the challenge of such indigenous music, they were duty bound to play as well as they could and play they did with astonishing virtuosity. It would be hard to single out those in the orchestra to whom special credit

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

should accrue but, in general, the outstanding thing was the fine smooth precision and lush tone of the strings and the mellow richness of the woodwind. Soundwise this is characterized by its ultra-cleanness. There is no edge on those superb strings, the brass, especially French horn sound, is quite weighty and sonorous, and the woodwinds have a great projection with wonderful articulation. Very wide dynamics here and with all enrobed in spacious acoustics, the presence is fabulous.

BERLIOZ
DAMNATION OF FAUST
(EXCERPTS)
LISZT
MEPHISTO WALTZ
SMETANA
MOLDAU
WEBER
INVITATION TO THE DANCE
Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML5261. Price $3.98.

Here is a potboiler potpourri to end them all! I suppose material like this sells very well and I admit it has its place in building the libraries of those people who are just becoming interested in classical music . . . but surely the powers-that-be at *Columbia* can find something more worthwhile to record with such a great orchestra as the Philadelphia. For what it is, it is quite good . . . Ormandy's performances are a bit on the "slick" side, a trifle superficial, but nonetheless representative and with the advantage of superlative playing from the Philadelphians.

Soundwise, this is big and bright with plenty of dynamics. String sound tends to be a bit "steely" and strident at times and I would have preferred more definition to the bass but, all-in-all, this is a good recording.

DVORAK
SYMPHONY #4
SCHERZO CAPRICCIOSO
Halle Orchestra conducted by Sir John Barbirolli. Mercury 50162. Price $4.98.

This is the sixth recording to appear on LP of the Dvorak "4th Symphony," but in terms of modern hi-fi sound it is only the second such recording. The *Angel* version with Swallisch was a fine job of sound and an excellent performance. Compared to this recording, however, it loses much luster. This is really superb in terms of musical balance, wide-range dynamics, pristine clearness in general, and the climaxes in particular. Even near the inner grooves, distortion was not audibly evident. The brass here is full and ultra-sonorous and string tone very smooth and lush. Barbirolli is thoroughly at home with these Dvorak scores and his reading is most exemplary. His approach is lyrical as it should be—but unlike some others he does not get too "sticky" and lay on the *gemutlichkeit* too thickly. There is fiber and strength here, giving substance to the melodic invention. The "Scherzo" is delightfully handled—briskly paced, neatly expressive, light in weight.

Mercury has arrayed both works in spacious acoustics, but has retained all the fine-grained orchestral detail with its famous *Telefunken* mike placement. This should be a "must" for Dvorak enthusiasts.

BACH AT ZWOLLE
E. Power Biggs, organist. Columbia KL5262. Price $3.98.

This is a record for the organ enthusiast and particularly for those whose tastes favor the baroque instrument. They've got one of the finest examples of that type here, the Arp Schnitger organ in the 15th century Gothic Church of St. Michael at Zwolle, Holland. The peripatetic organ-tester, Mr. Biggs, deserves a vote of thanks for bringing the sounds of so many of these fine old instruments to us over the past few years. He essays a Bach program on this organ, playing with his usual skill and taste such diverse items as the "D Major Prelude and Fugue" ("The Great"), the "C Minor 'Arnstadt' Prelude and Fugue," and the familiar "'St. Anne' Prelude and Fugue." There is plenty of church reverb here, but not so much that the sonic lines are completely blurred. The sound is typical of most Arp Schnitger organs . . . pitched a bit on the high side, with the usual nasal, "breathy" reed sound, very sharp and acute.

This is one of the few four-manual tracker action organs ever built and of course this type of action allows a great deal of individual control over attacks and ritards and makes for very expressive playing. The voicing of this particular instrument is very clean and clear and is eminently suited to works such as those by Buxtehude, Pachelbel, Sweelink, Frescobaldi, etc. Hi-fi organ lovers are warned that this is not a big "showy," theater organ sound and while there is some fairly low-frequency pedal here, it is very definitely not of the house-shaking variety, if that is what you want.

VIENNA DANCES
Vienna State Opera Orchestra conducted by Anton Paulik. Vanguard VRS1019/22. Price $11.90. Four discs.

If you are a lover of Strauss Waltzes, this is an absolute "must." This is the biggest package . . . four 12" LP's . . . and biggest bargain . . . less than three dollars per record, ever available to Strauss devotees. The entire Strauss dynasty is represented with 17 of the great waltzes and 19 polkas, marches, and galops. But bargain though it is, it is in no way a cheap production. For one thing the redoubtable Anton Paulik is on hand to conduct and, as always, he is authentic, authoritative, and enjoyable. Few other conductors can summon the "gemutlichkeit" quite in the manner of Paulik. To Paulik, these Strauss pieces are light confections, to be played with grace and verve and not to be hammered to death in the grand symphonic manner as is the wont with so many less discerning conductors.

As a further bonus, *Vanguard* has imbued these delightful works with its very best sound. Recorded in the Musikverein in Vienna they are, without exception, clean and conspicuously free from distortion. The general impression is of rich full sound, with the superb acoustics lending an aura of compelling realism. Needless to say the orchestra is engaged in a labor of love and this is audibly evident in their wonderful playing. This is an album that will be treasured by many and I can say nothing more than that it is recommended to you without reservation.

ON THE CHICAGO SCENE
Max Roach plus Four. EmArcy MG-36132. Price $3.98.

That drummin' man Max Roach has his new "Four" with him on this disc and he is in a strictly upbeat "Chicago" mood. With Eddie Baker on the piano, Bob Cranshaw on bass, George Coleman on the tenor sax, and Booker Little riding on the trumpet, and old Max blasting on the skins this disc really has drive and really moves. The boys run through six oldies like "Stella by Starlight", "My Old Flame", "Stompin' at the Savoy", etc. and the pace they set is rather on the frenzied side. The sound is one of the best of the Max Roach series. Very close-up recording with sensational definition on the drums and all other instruments quite sharply focussed. —30—

Photorhythmicon

(*Continued from page* 51)

superb brilliance indoors with normal room lighting. At night, with all other lights out in the room, the effect is dazzling. It holds the viewer spellbound with the same pleasantly hypnotic effect as the flames of a roaring fire on the hearth.

Circuitry of the Photorhythmicon can be traced by referring to the schematic of Fig. 1. V_1 is a 12AX7 twin-triode tube. Both triodes are connected in parallel to gain good voltage preamplification. That is the sole purpose of this stage. The input to the chassis is shown as low resistance for operation with home high-fidelity equipment as the signal source, connecting directly across the voice-coil output of the high-fidelity amplifier. Of course, other input resistances, isolating capacitors, and bridging or matching transformers could be used for connection to this or other signal sources. The only important considerations are that the input network be resistive in its electrical characteristics, that is to say the input circuit should not offer frequency discrimination to the grids of V_1, and that the input circuit should not load the signal source. The input circuit draws virtually no power for full brilliance.

The output of V_1 feeds three circuit branches: lights right, lights center, lights left. These branches are frequency selective. Their particular "bands" of frequencies are made deliberately broad (see Fig. 2). It was found that if sharp frequency rises and cut-offs are provided at the edges of these "bands," the actions of the lights with respect to the sounds actuating them are not smooth. By allowing considerable overlap in bandwidths, the effect of light "flow" as in an arpeggio is neatly accomplished, one group of lights dissolving as the other begins to brighten.

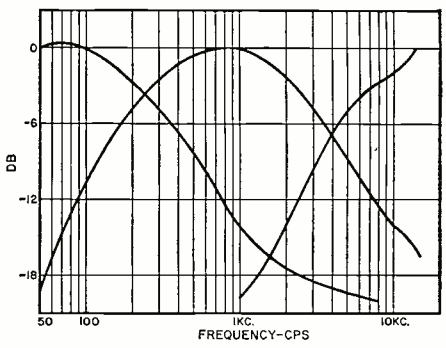
The first triode sections of V_2, V_3, and V_4 provide additional voltage amplification for the frequency discriminated signals appearing at their control grids. The second triode section of each of these tubes is operated as a rectifier (grid and plate connected together) for the a.c. signal output of the first triode section. The cathode of each of these "rectifier" sections is connected to the control grid of its corresponding light-control tube, a 6CL6. In this manner the control-grid of each 6CL6 is driven more positive in accordance with frequency and amplitude of the input signal—corresponding to bass, middle, and treble spectra, and to the lights left, lights center, and lights right.

Only minimal filtering is required in the power supply. C_{10} gives all the filter action necessary for V_2 through V_7. C_{11} and R_3 form a decoupling network for V_1. The power transformer used in this construction was originally intended for replacement purposes in a TV set. The total current drawn from the high-voltage winding, with the cathode currents of the light-control tubes at their resting points, is 80 milliamperes. The total current drawn with all bulbs glowing at full brilliance is 180 milliamperes. The plate voltage varies 50 volts with this load change. This does not appear to have a deleterious effect on performance. It is recommended, however, that the power transformer selected be capable of delivering 300 volts at 150 milliamperes in order to assure good performance.

To enhance the over-all effect, the bulbs should be dipped in translucent lacquer. A kit of colors for pilot lights is available through parts distributors. There is considerable discussion among those who have witnessed demonstrations of the Photorhythmicon concerning which color represents bass, which represents middle, and which is best for treble. It would be of little value to reveal which colors the author prefers. This becomes a matter of personal preference, it appears. There may be some definitive research on the relationships of sight to sound. This research, if available, would no doubt lend authority to one's selection of colors.

At first sight and study of the schematic for the Photorhythmicon one notes that an electrolytic capacitor is provided at the cathode of the 6CL6 tube serving in the *bass* channel; but there are no such capacitors at the 6CL6's in the *middle* and *treble* channels. This is not an oversight nor an error in drawing the diagram. Capacitor C_8, the electrolytic, fulfills a rather interesting purpose. It serves to damp the speed of the extinguishing action of the lights in this channel. It sustains the "glow" for a fraction of a second. The effect is that the visual bass or rhythm section of the musical group is sustained and visual vibrato in this light channel is diminished. The viewer gains the impression of a "softer" action which is more pleasing than when C_8 is omitted. The musical accent is emphasized. Should one of the bass-lights burn out or become open, the full plate voltage, in series with the d.c. resistance of the 6CL6, is applied to C_8; hence the high voltage rating of this capacitor. —30—

Fig. 2. Shown below are the frequency response curves for the three channels.



A Color Case History

(*Continued from page 55*)

ponents. After checking the schematic diagram again, Harry decided to try replacing the 2- and 6-$\mu\mu$fd. capacitors in the oscillator circuit, thinking that perhaps one or both may have been overheated and shifted enough in value to disrupt the oscillator. Apparently this was not the case, for the replacement capacitors, like all the other attempts at repair, failed to remedy the difficulty.

Harry leaned over the bench, placed his head in his hands and gazed idly at the schematic for the fifth time. He wasn't really looking at the diagram, but wondering how he would explain his failure to the set owner. Then all of a sudden it hit him like a bolt of high-voltage: the coil in the screen grid of the oscillator had an adjustable core!

Harry had noticed this adjustable coil when he first began troubleshooting the oscillator, but disregarded it because the color section had gone dead suddenly and not gradually as it would in a case where a factory adjustment goes faulty. Since this inductor was part of the feedback circuit, Harry now thought it reasonable to assume that its adjustment would affect the grid voltage. He grabbed the v.t.v.m. and hurriedly clipped into the grid circuit of the oscillator. As he carefully adjusted the core, the v.t.v.m. needle slowly began to swing up scale. He continued to adjust the core until the correct grid voltage (−2.5 volts without the burst) was indicated by the meter. A blue haze was now visible just inside the 6CB6 and the cherry-red glow on the plate disappeared. Harry leaned back on his stool and began to feel relaxed for the first time in many days.

Harry positioned himself over the schematic. He was still puzzled by the fact that the oscillator had functioned normally for nearly eight months with factory adjustment of the feedback coil, and then failed to oscillate with tubes he knew were fresh. The more he thought about it the more he became certain that it had something to do with the tubes' characteristics. While turning this thought over in his mind, the answer occurred to him. Mutual conductance. He reasoned that a 6CB6 that happened to have an unusually high G_m rating was installed in the receiver by the manufacturer, and the feedback coil was adjusted for the correct grid bias with this tube in the circuit. When the high G_m rating fell off due to normal aging of the tube, the amount of feedback and consequently the grid bias decreased, allowing the tube to conduct excessively. This of course disrupted oscillatory action and resulted in the "routine" service call. The big service headache?—it happened because Harry's 6CB6's had slightly lower than average G_m ratings! —30—

KT-500 IN KIT FORM 74.50

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THE MOST FLEXIBLE TUNER EVER DESIGNED

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- Dual Cathode Follower Output
- Armstrong Circuit with FM/AFC and AFC Defeat
- Dual Double-Tuned Transformer Coupled Limiters.

More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control "locks in" FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter, built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8-kc bandwidth and frequency response 20-5000 cps ± 3 db.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 22 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

KT-500 ..... Net **74.50**

LT-50 Same as above, completely factory wired and tested ..... Net **124.50**

KT-310

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47.50

NEW! LAFAYETTE STEREO/MONAURAL BASIC POWER AMPLIFIER KIT

- 36-WATT STEREO AMPLIFIER- 18-WATTS EACH CHANNEL
- FOR OPTIONAL USE AS 36-WATT MONAURAL AMPLIFIER
- EMPLOYS 4 NEW PREMIUM-TYPE 7189 OUTPUT TUBES
- 2 PRINTED CIRCUIT BOARDS FOR NEAT, SIMPLIFIED WIRING
- RESPONSE BETTER THAN 35-30,000 CPS ± ½ DB AT 18 WATTS
- LESS THAN 1% HARMONIC OR INTERMODULATION DISTORTION

A superbly-performing basic stereo amplifier, in easy-to-build kit form to save you **lots of money** and let you **get into stereo now** at minimum expense! Dual inputs are provided, each with individual volume control, and the unit may be used with a stereo preamplifier, for 2-18 watt stereo channels or, at the flick of a switch, as a fine 36-watt monaural amplifier — or, if desired, it may be used as 2 separate monaural 18-watt amplifiers! **CONTROLS** include 2 input volume controls, channel Reverse switch (AB-BA), Monaural-Stereo switch. **DUAL OUTPUT IMPEDANCES** are: 4, 8, 16 and 32 ohms (permitting parallel (monaural) operation of 2 speaker systems of up to 16 ohms. **INPUT SENSITIVITY** is 0.45 volts per channel for full output. **TUBES** are 2-6AN8, 4-7189; GZ-34 rectifier. **SIZE** 9-3/16"d (10-9/16" with controls) x 5¼"h x 13¼"w. Supplied complete with perforated metal cage, all necessary parts and detailed instructions. Shpg. wt., 22 lbs.

KT-310 Stereo Power Amplifier Kit ..... Net **47.50**

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KT-400 IN KIT FORM 69.50

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LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROL.

- Self-Powered
- DC On All Filaments
- 24 Positions of Equalization
- Tape Head Input, High Impedance
- Dual Cathode Follower Output Stages

This is not only the finest hi-fi preamp characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube filaments, negative feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.09% IM distortion and less than 0.07 harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phono, tuner or tape. Tasteful styling, brilliantly executed. Size 12¾ x 9⅛ x 3¾". Shpg. wt., 10½ lbs.

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DELUXE 70 WATT BASIC AMPLIFIER

- Conservatively Rated At 70 Watts
- Inverse Feedback
- Variable Damping
- Metered Balance And Bias Adjust Controls
- Available In Kit and Wired Form

Here's ultra-stability in a 70 watt basic power amplifier employing highest quality components conservatively rated to insure performance and long life. Features matched pair KT 88's and wire range linear Chicago output transformer, variable damping control, meter for bias and balance and gold finish chassis. Frequency response 10-100,000 cps ± 1db. Hum and noise 90 db below full output. IM distortion less than 1½% at 70 watts, less than 0.3% below 30 watts. Harmonic distortion less than 2% at 70 watts from 20 to 20,000 cps ± 1 db. Output impedance 4, 8 and 16 ohms. Handsome decorative cage perforated for proper ventilation. Size 14½ x 10 x 7⅜" including cage and knobs. Shpg. wt., 40 lbs.

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For FM-AM Stereo Reception.
For FM or AM Monaural Reception.
For FM Multiplex Reception (Requires Decoder).
For Separate FM & AM Simultaneous Listening In Different Rooms.

● Separate AM AND FM SECTIONS ● INDIVIDUAL PRECISION FLYWHEEL TUNING ● 4 FM IF STAGES WITH DISCRIMINATOR ● ARMSTRONG FM CIRCUIT ● FM RESPONSE 20-20,000 CPS ± 1 DB ● FM SENSITIVITY 3 MICROVOLTS ● DRIFT-FREE FM WITH AFC & AFC DEFEAT ● OUTPUTS FOR AM/FM MONAURAL, AM & FM STEREO, STEREO OR MONAURAL TAPE RECORDING, FM MULTIPLEX ● HANDSOME, MODERN HI-FI STYLING

LAFAYETTE is happy to be able to announce this excellent stereo tuner with its many outstanding features; its low cost and high degree of flexibility combine to make it practicable to enjoy stereo FM/AM broadcasts **NOW** without fear of obsolescence. **SPECIFICATIONS: Sensitivity** — FM 3 microvolts for 20 db quieting; AM 75 microvolts loop sensitivity. **Selectivity** — FM 200 kc. bandwidth at 6 db down; AM 7 kc. at 6 db down. **Frequency Response** — FM 20-20,000 cps ± 1 db; AM 20-5,000 cps ± 2 db. **Output Voltages** — FM 2½ volts for 100% modulation; AM 1 volt average. **Hum** — 70 db below 1 volt. **Output Jacks** — AM/FM Monaural, AM Stereo, AM Tape Recording, FM Tape/Multiplex. **Controls** — Stereo-Monaural Switch, Selector Switch (AM, FM-AFC, FM, Off), AM Tuning, FM Tuning, Multiplex-Tape Switch (rear panel). **Built-in FM and AM Antennas:** with provision for connecting external antennas. **Tubes** — 6BE6, 2-6BA6, 6U8, 12AT7, 6AU6, 6AL5; diode AM detector, selenium rectifier. **Auxiliary AC Outlet. For 105-120 volts, 50/60 cps AC. Size** — 8½"d. (10½" including knobs and ferrite loop) x 13-5/16"w x 4¼"h (add ⅜" for rubber feet). **Shipping Weight** — 16½ lbs.

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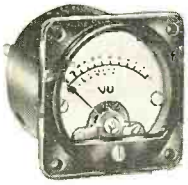
● MINIATURE PANEL METER, ONLY 1½" SQUARE ● 2% ACCURACY
● INDICATES OUTPUT LEVEL WITH COMPLEX AUDIO WAVEFORMS
● STANDARD VU METER DAMPING



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Volume level indicator, calibrated in standard −20 to +3VU and 0-100% ranges. Uses precision carbon film multiplier resistor and full-wave rectifier. Damped in accordance with standard VU meter requirements for faithful indications of actual sound levels. 0-100% scale used to indicate percent use of amplifier output or percentage of correct tape recorder recording level without referring to VU scale. 1¼" dial face, silvered dial, black numerals and pointer. Requires only 1½" diam. panel hole for mounting. Clear optical glass front. Shpg. wt., 8 oz.

TM-10 ..... Net **3.95**

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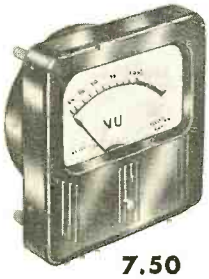

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● JEWELLED BEARINGS ● 2% ACCURACY
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A high-quality precision built unit, only 3⅛" square, 2-5/16" x 1⅜" silvered dial face, 1-11/16" overall depth. Black pointer, highly legible black calibrations. Clear optical glass front. "B" scale, has 0-100% on upper scale, −20 to +3 VU on lower scale. Reads 99% of applied VU in 0.3 secs., with overshoot between 1-1 ½%. Calibrated for 0 VU when 1.228 volts sine wave AC applied through external 3600 ohm series resistor from a 600 ohm source with 600 ohm load. 6-8 volt scale illuminating lamp. Shpg. wt., 1 lb.

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NOT A CLOSEOUT—NOT A DISCONTINUED Model, this is a nationally advertised, latest model record changer, with new GE VRII Series Triple Play Cartridge with G. E. Genuine diamond and sapphire stylii and is priced so low that we DARE NOT mention the manufacturer's name. This fully automatic record changer has exclusive and deluxe features for the finest hi-fi systems, such as automatic intermix, muting switch, click filter and automatic shut-off after last record. Heavy duty 4-pole shaded pole motor with heavy rim-weighted turntable. 4 speeds, 78, 45, 33⅓, 16-2/3 RPM. Negligible wow and flutter. We are so confident that you will be happy with this purchase, that if for any reason you do not feel you have received an exceptional value, we shall cheerfully refund your purchase price. Size 12¼" x 13¾", requiring 11/16" clearance above and 2-11/16" below motorboard. Shpg wt., 21 lbs.

PK-250 RECORD CHANGER (less woodbase) with NEW GE 4G-052 Diamond Sapphire Cartridge ..... Net **39.50**

MAHOGANY OR BLONDE WOODBASE CUT TO FIT ABOVE

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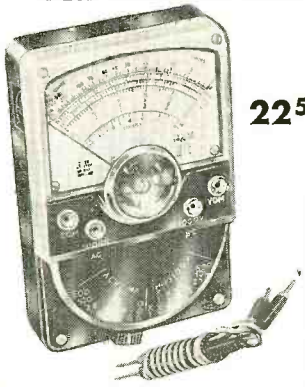

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● 20,000 OHMS PER VOLT DC
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A terrific buy in a hand-held, compact, light, accurate, completely wired instrument. Has a 38 μA movement, 1% precision resistors and simple selector switch with calibration markings protected against wear. Scales: Volts DC and AC; 0-5, 25, 100, 500, 1000; Ohms: 0-6K-600K — 6 Meg — 60 Meg. DC Current: 0-50 μA — 5-50-500 MA: Decibels — −20 to +64 in 5 ranges. Size 4⅝" x 2⅞" x 1¼". Shpg. wt., 1 lb. Complete with batteries and test leads. Imported to save you money.

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New! Lafayette 4-SPEED PROFESSIONAL TRANSCRIPTION PLAYER WITH 3 LB. 12" ALUMINUM TURNTABLE

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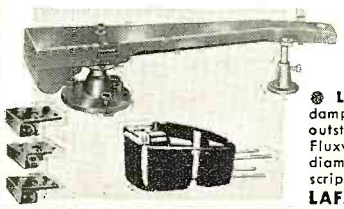
ONLY 37.50

● IDEALLY SUITED FOR STEREO! ● BETTER THAN −50 DB RUMBLE & NOISE ● VIBRATIONLESS MOTOR SUSPENSION ● BELOW 0.2% WOW & FLUTTER ● MAGNETIC EDDY-CURRENT BRAKE ● 3 LB. 12" BALANCED & MACHINED ALUMINUM TURNTABLE ● SPEED CONTROL FOR ± 10% VARIATION OF EACH SPEED

An amazingly low price for the superior quality embodied in this fine instrument. Features include heavy, rim-weighted, 3 lb. machined-aluminum 12" turntable, magnetic brake with speed control for ± 10% variation of each speed; the extremely low noise and rumble figure of −50 db below average recorded level; wow and flutter (speed variations) of less than 0.2%; new-type oversize precision-ground idler with special lubrication features; positive-locking detents on 4-speed single-knob speed selector; ("off" positions between all speed positions; free-floating shock-mounted motor; automatic idler disengagement in "off" positions; precision spindle turns on single ball bearing; heavy duty 4-pole induction motor. Heavy rubber turntable mat. For 105-120 volts, 60 spc AC; draws 0.13 amperes. Size of motor plate 11" x 10" x 14½"; requires 4" below mator board, 1½" above. Complete with stroboscope disc, 45 rpm adapter, AC line cord. Shpg. wt., 14 lbs.

PK-240 12" TRANSCRIPTION TURNTABLE ..... Net **37.50**



LAFAYETTES SPECIAL-VALUE COMBINATION

● **Lafayette Model PK-170** 16" viscous-damped transcription arm, equipped with the outstanding new Pickering Model 371D Stereo Fluxvalve magnetic cartridge with 0.7 mil diamond stylus, and the Model PK-240 transcription turntable.

LAFAYETTE SPECIAL! Net **79.95**

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Service Notes

OVERHEATING WIDTH COIL

On all *Philharmonic* models in which the high-voltage transformer is in a cage on top of the chassis and which use a 6BQ6 as the horizontal-output tube—particularly those in the 800 or 900 series—the width coil may tend to overheat. This may occur if the proper width adjustment involves having the slug of the width coil turned all the way out of the form. If this situation cannot be remedied by turning the slug into the coil while retaining satisfactory width, either of two measures may be adopted. Substitution of a new width coil having less inductance (Part No. 10-575) is one approach. Alternately, it is possible to remove about 80 turns from the existing width coil. This will make it possible to obtain the same width setting previously available but with the slug farther into the coil.

H. V. ARCING, ADMIRAL

If any receiver using a 24-inch picture tube in conjunction with the 18X4FZ chassis should develop arcing in the high-voltage section, the symptom can probably be eliminated by a simple change, involving the addition of a capacitor and the removal of a resistor. The capacitor, a 33-$\mu\mu$fd., 3000-volt, ceramic unit, is shunted across the horizontal windings of the deflection yoke in the manner shown

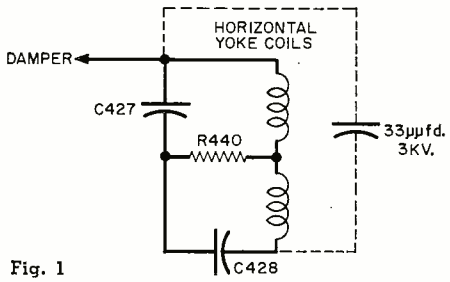


Fig. 1

in Fig. 1. The resistor, not shown, is in series with the second-anode lead from the high-voltage rectifier to the picture tube. After removal of the resistor, the second-anode lead connects directly to pin 5 of the rectifier (V_{406}, 1X2B).

The capacitor was added at the factory in later production of this receiver. In earlier chassis, the resistor, R_{443}, will not always be present.

MAJESTIC: FM DRIFT

On TV combination receivers using the 801 or 802 AM-FM chassis, excessive drift may still be evident in the FM position even after a 15-minute warmup period. This condition may be stabilized by replacing the FM oscillator capacitor, C_{12}, with one having a more suitable temperature characteristic. Originally C_{12}, which is conveniently located on top of the ganged tuning capacitor, was a 4.7-$\mu\mu$fd. ceramic unit. The replacement is a 5-$\mu\mu$fd. ceramic capacitor having a temperature coefficient of N750. It is available as Part No. B-4.137-1. To compensate for the slight difference in value between the original capacitor and its replacement, it is possible to re-adjust C_{11}, the FM oscillator trimmer, also located on top of the tuning capacitor, without instruments. The following procedure is used:

Before replacing C_{12}, turn on the receiver and tune it to an FM channel that is the closest in frequency to 108 mc. of those transmissions that are available. Without changing the position of the tuning capacitor, turn the receiver off and replace C_{12} with the temperature-compensated unit.

Now turn the receiver on again and, still without touching the main tuning capacitor, adust C_{11}, the FM oscillator trimmer, until the same FM station that was received before is again received at this same point on the dial. Certain TV combination models using these AM-FM chassis already have the compensating capacitor incorporated.

PHILCO: INSUFFICIENT WIDTH

If TV receivers using deflection chassis J-4 cannot be adjusted to provide sufficient raster width, a simple correction, incorporated in later-production units, can correct this condition. Locate resistor R_{818}, a 22,000-ohm, 2-watt unit connected between lugs 4 and 7 on terminal board B_2. (Refer to Fig. 2.) This unit should be

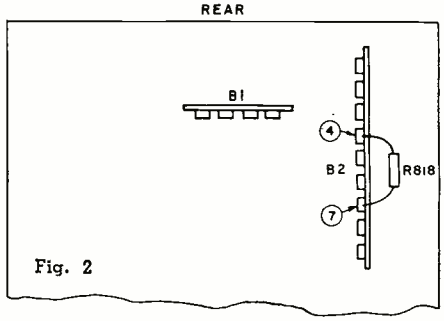


Fig. 2

removed and replaced by a 33,000-ohm resistor. Locate resistor R_{813}, a 470,000-ohm unit connected between terminals 5 and 6 of the horizontal-output tube socket. This should be removed and replaced with another whose value is 270,000 ohms.

MOTOROLA CLOCK-RADIO STATIC

Noise in Model 66C clock radios may result because the radio dial background is making intermittent contact with the background for the clock dial. This can be eliminated either by making certain that the two backgrounds are making good, permanent contact with each other or by eliminating this contact altogether. An easy way to eliminate the contact is to bend the radio dial background slightly back, just enough so that it cannot touch the clock. —30—

NEW 1959 MODEL HIGH-FIDELITY SPEAKER SYSTEM ON BAFFLE BOARD $29.95

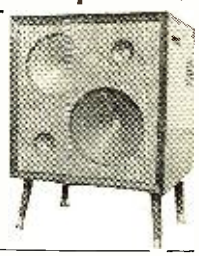
FEATURES 15 INCH MAGNAVOX WOOFER 12 INCH MID-RANGE MATCHED TWEETERS

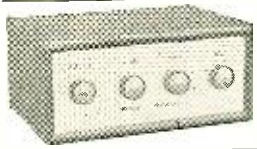
Model VOX-1512, high fidelity 25 watt, 4-way speaker system. Factory manufactured on a baffle board 16" x 32". The speakers featured in this system have been laboratory matched to work as a team to bring you the widest audio response and the nearest to natural listening as possible. Our Audio Lab worked out this system with its own engineers. Then the finished speaker system was tried and approved by side-by-side comparison with speaker systems selling for $200.00. We think that its the most value that we have ever offered for the money. Ideal for use with any good audio system. (Impedance 4 ohms). Or, buy a matched pair for your Stereo Hi-Fi system. Mount them in any enclosure or use them just as they come. Features a Magnavox Alnico V 15" PM woofer, 12" Magnavox mid-range, 5" cone tweeter and 4¼" deep horn type cone tweeter. Speakers are matched; connected together with capacity-reactance to make each speaker do its share. Stock No. VOX-1512, 4-way speaker system, Sale price, $29.95, 2 for $57.95. Choice of blond or mahogany plastic grill cloth for above, $1.25 extra. Response 20 to 22,500 C.P.S.

NEW 1959 HI-FI SPEAKER IN ENCLOSURE

New, 1959 model 4-way speaker system is a fully enclosed baffle 37" high, 27" wide and 23¾" front to back. Tone equal to high priced nationally advertised systems. Incorporates the same speakers as offered in the VOX-1512 system at left. 25 watts, response 20 to 22,500 cps. Impedance 8 ohms. Equipped with plastic grill cloth. Illustrated with grill cloth removed to show speakers.
Model McVOX-151254, Mahogany finish, $49.95.
Model BcVOX-15122, Blond finish, $54.95.

$49.95





16 Watts Factory Wired Hi-Fi Amp

$34.95

Combination offers: SL-20 and B-125X speaker board, $51.95. SL-20 and VOX-1512, 4-way speaker board, $61.90. SL-20 and McVOX-151254 speaker system, $79.95.

New, 1959 model Imperial Slim-Line 16 watt high fidelity amplifier (20 watts peak), with built-in pre-amplifier. Full range audio response from 15 to 22,000 cps. Dual tone controls; full 18 db bass and full 15 db treble boost. Input for radio tuner, tape recorder and phono. Input compensation for the new 1958 model, 4 gram General Electric variable reluctance cartridges, as well as the famous G.E. RPX-050, RPX-052 and crystal phono cartridges. 5 position selector switch selects inputs and record compensation. Compensation for AES and RIAA phono records. A factory built amplifier at less than kit prices. Output impedance matches 8 or 16 ohm high fidelity PM speakers. Price includes tubes: 2—12AX7, 1—12AU7, 2—EL84 and 5Y3GT. Modern multi-color leatherette covered wood cabinet at no added cost; matches blond or mahogany finish speaker systems. Size: 5¼" tall, 11¼" wide, 8" front to back. Ship. wt. 15 lbs. Model SL-20 Imperial, List price, $69.50. McGee's Sale price, $34.95.

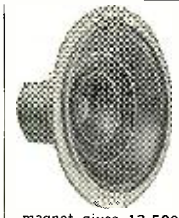
TREMENDOUS McGEE VALUE—NEW 1958 HI-FI SPEAKER SYSTEMS ON BAFFLE BOARDS

Model B-125-X, high fidelity 15-watt, 5-way speaker system, mounted on an 18" square baffle board. Has 12" High Efficiency woofer, 2—4x6" mid-range speakers, plus a 4" high-range and 3" tweeter; all with Alnico V magnets. Built-in crossover network with variable brilliance control. Ship. wt. 11 lbs. Stock No. B-125-X, 5-way, 15-watt Hi-Fi speaker system. AUDIOPHILE VALUE $30.00. SALE PRICE $18.95.

SALE PRICE **$18.95**

DELUXE HI-FI 25 WATT SPEAKER BOARD $29.95

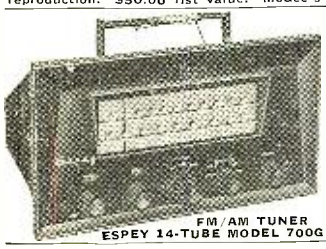
Model B-250X, 4 matched Hi-Fi PM speakers mounted on a baffle board, 18" wide and 30" tall. For installation in your own cabinet or play as it comes. Features 15" woofer, 10" mid-range, 5¼" and 5" tweeters; built-in proper LC cross-over network. System is wired ready to connect the two leads to any 8 ohm amplifier or FM-AM radio. 25 watts capacity, from 18 to 17,500 cps. AB matched for finest audio reproduction. $50.00 list value. McGee's sale price, $29.95.



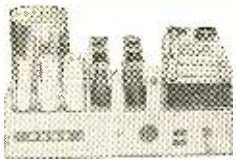
World Famous Imported from Holland NORELCO HI-FI PM SPEAKERS

12" Model 9762-M reg. $59.97 Sale Price $39.95
12" Model 9760 reg. $32.97 Sale Price $19.95
8" Model 9750 reg. $22.17 Sale Price $15.95

NORELCO Model 9762—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice Coil imp. 8 ohms—new Alnico VI magnet gives 11,000 gauss. Regular $59.97 net, on sale at McGEE for only $39.95.
NORELCO Model 9760—12" wide range Hi-Fi PM speaker, res. 35 to 18,000 cps at 30-watts. Voice coil imp. 8 ohms—new Alnico VI magnet gives 8,000 gauss. Regular $32.97 net, on sale at McGEE for only $19.95.
NORELCO Model 9750—8" wide range Hi-Fi PM speaker, res. 50 to 20,000 cps at 10-watts. Voice coil 6 ohms—New Alnico VI magnet gives 13,500 gauss. Regular $22.17 net, on sale at McGEE for only $15.95; or 2 for $30.00.



FM/AM TUNER
ESPEY 14-TUBE MODEL 700G



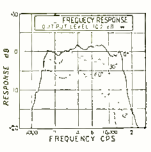
ESPEY 24 WATT
MODEL 501G AMPLIFIER

22 TUBE ESPEY FM-AM TUNER-AMPLIFIER

SALE PRICE **$99.95**

Espey Model 700G-501G, complete 14 tube FM-AM tuner and matching 8 tube, 24 watt ultra-linear amplifier. A regular $199.50 value on sale at McGee for $99.95. Features AFC on FM. Receives broadcast 550 to 1700 kc and FM, 88 to 108 mc. Built-in preamplifier. Separate bass and treble controls, record equalization. Response, 10 cps to 20,000 cps, auxiliary input jacks. Tuner chassis is 14" long, 8½" high, 10" deep. (Leatherette cabinet for tuner only, $7.95 extra.) Amplifier 12"x8"x5" (push-pull, parallel 6V6 output tubes). Price includes all tubes, knobs and escutcheon plate. Shipping weight 42 lbs. A true McGee value.

Combination offer with Garrard RC-98 changer and 4G-052 G.E. cartridge, $174.95, no speaker included. Why not order a Norelco or our new B-250X speaker board with your Espey?



HEAR BETTER-Hi-FREQUENCY NEW 1959 MODEL 20-WATT SUPER TWEETER—$35.00 List

$12.95

McGee's 1959 Model imported 20 watt Super tweeter. Equals American tweeters with from $25.00 to $50.00 list price. Use with any woofer or attach to your present speaker. Simply couple through a 2 mfd. capacitors. Violins, pianos and all instruments above 1500 CPS sound more natural. Response from 1700 to 22,500 CPS. Down 20 db at 22,500 CPS. Smooth uniform response from 1700 to 16,000 cps. May be mounted in or used outside of your speaker baffle. V.C. impedance 8 ohms. Flux density 13,500 gauss. 32,500 Maxwells. Size, 4¾"x2"x4¾" deep. All metal construction, finely finished. Stock No. AT-3, McGee's Sale Price, $12.95. Include 50¢ for postage.

GET McGEE's 1959 CATALOG FREE

Mail Your Request Now. Fall Cat. 1001 Bargains. Hi-Fi, Electronic, Radio and TV Parts.

24 INCH CUSTOM TELEVISION CHASSIS

$129.95

McGee offers this nationally famous make 24" television chassis with aluminized picture tube at a terrific saving. Full power transformer operated with switch type cascode tuner. All regular wiring—no printed circuits. Chassis is mounted on a baseboard and shipped with picture tube installed. Area required for chassis: 28" wide, 20" high and 20" front to back. Safety glass size, 23 13/16"x19¾". Tuner and controls are mounted on a separate vertical bracket to make it easy to move when installing. Price includes all tubes and 24" 24YP4 aluminized picture tube. Knobs and safety glass included. Good quality audio. 2—8" and 2—5" speakers are furnished, mounted on a baffle board 24"x19¾". Stock No. MG75-02, with all tubes and 45 day picture tube warranty. Sale price, $129.95. Price with one year picture tube warranty, $133.95.
Stock No. MG75-02-HF10, same as MG75-02 except with push-pull 6V6 Hi-Fi amplifier and with 2—12" PM's and 2—5" tweeters on a baffle board. Sale price, $149.95.
Stock No. MG75-01, similar in appearance to the 24" model illustrated, except set includes a 21" 21ATP4A aluminized picture tube. McGee's sale price, $99.95 with 45 day picture tube warranty. 1 year picture tube warranty, $4.00 additional.
3 speed automatic Collaro record changer, plugs into any of the above TV chassis, $24.95 extra.

ALLIANCE "IT" T.V. TUNER REMOTE CONTROL REG. $19.50 LIST

$4.94

McGee Special Purchase Sale! Alliance "IT" remote tuner for your TV set. A small battery operated motor turns your tuner clockwise or counter-clockwise. Attractive bakelite case fits palm of your hand. Made to sell at over $14.00 dealers net. McGee offers them for $4.94, 3 for $12.50 with flashlight batteries. Also adaptable to many other uses. Add 40¢ per unit for packing and postage.

AUTOMATIC CHANGERS AT LOW PRICES

Special prices on VM 3 speed Hi-Fi record changers. Equipped with plug-in heads. Features 4 pole motor, intermixes 10" and 12" records of the same speed, shuts off after last record has played. Size: 13½"x13¼". Ship. wt. 12 lbs. VM-935 and VM-936 are the same changer except the 936 is on a base as illustrated. Price includes 45 RPM spindle.

MONARCH UA8H $22.95

VM-936HF $32.95

VM-935HF with RPX-050A G.E. VR cartridge, $29.95.
VM-936HF on base with RPX-050A G.E. VR cartridge, $32.95. 1 mil diamond needle, $4.95 extra.

Latest 4 speed English imported Monarch record changer. Features a 4 pole motor, 9" turntable with molded rubber record pallet. Balanced tone arm readily accepts most makes of Hi-Fi cartridges. Plays 16⅔, 33⅓, 45 and 78 RPM records. Intermixes 10" and 12" records of the same speed. Shuts off after last record has played. Compact size, 12¾"x 10⅞". Ship. wt. 15 lbs. Large 45 RPM spindle, $1.88 extra. Choice of blond or mahogany wood mounting base, $4.50 extra. Offered with several types of cartridges.
UA8-H with Ronette flip-over Hi-Fi crystal cartridge, $22.95.
UA8-RD with Ronette cartridge as above and extra 1 mil diamond needle, $29.95.
UA8-4G050 with latest G.E. VR cartridge, $29.95. 1 mil diamond needle, $4.95 extra.

Latest Garrard Renown II, RC-121 II, latest 1958 Garrard Hi-Fi, 4 speed changer with plug-in head shell, Net $42.50, with G.E. 4G-050 cartridge, $51.45, with G.E. 4G-052 cartridge, $61.80. 45 RPM spindle, $3.50 extra.

3 SPEED HI-FI COLLARO

Model RC-54, 3 speed (33⅓, 45 and 78 RPM) Collaro record changer. A late model High Fidelity record changer with a ceramic crystal cartridge (no pre-amplifier required). Features diamond 1 mil and sapphire 3 mil needle, 4 pole motor. Base size, 12" x 13¼". For 110 volt, 60 cycle AC operation. These changers were intended for use by a nationally known Hi-Fi set manufacturer. McGee bought them at a substantial saving. Stock No. RC-54 Collaro changer with crystal cartridge, equipped with diamond 1 mil and sapphire 3 mil needle. McGee Sale Price, $27.95.

$27.95

Tan leatherette covered wood base, 13 x 14½ x 3⅞", shipped separate at $3.65 extra.

RCA Reg. $119.50 RADIATION COUNTER ON SALE AT McGEE for $29.95

RCA Model WF-10A, Radiation Geiger counter for amateur and professional use. Explore for Uranium or check for atomic fall-out radiation. Complete with test sample. Simple to use, weighs only 5 lbs. In aluminum case. 7¾"x8½"x3½". Indicates presence of radioactivity in 3 ways, by meter, neon light and headphones. Requires 2—67½ volt Burgess XX45 "B" batteries and 3 =2 flashlight cells. Battery kit, $5.29 extra. 3 sensitivity ranges, 0-100, 0-1000 and 0-10,000 counts per minute. A terrific value from McGee. RCA Model WF-10A with tubes and headphone, less batteries, $29.95. Battery kit, $5.29 extra.

MODEL WF-12A *Regular $149.50*—McGEE'S PRICE—$34.95

RCA Model WF-12A, Radiation Geiger counter. Similar to WF-10A, except has an external probe. Priced with tubes and headphones at $34.95, less batteries. Kit of 2—XX45 Burgess "B," plus 3 =2 flashlight cells, $5.29 extra.

MODEL WF-11A *Regular $154.50*—McGEE'S PRICE—$37.95

RCA Model WF-11A, Radiation Geiger counter. Explore for Uranium or check for atomic fall-out. Uses extra sensitive Bismuth tube. Test sample included. Simple to use, weighs only 5 lbs. Weatherproof case 7¾"x8½"x3½". Indicates presence of radioactivity 3 ways, by meter, neon light and headphones. Requires 2 Burgess XX45 "B" batteries and 3 =2 flashlight cells. Battery kit $5.29 extra. 3 sensitivity ranges, 0-200, 0-2000, 0-20,000 counts per minute. A terrific value. RCA WF-11A, Sale price, $37.95 with tubes and headphone. Battery kit, $5.29 extra. Similar size to WF-10.

RCA Model WF-15A (not illustrated). Has 10 sensitive tubes, 3 ranges to 100,000 counts per minute. Size, 11"x47/8"x7½". Weight 8 lbs. Original price, $475.00. McGee's Sale price, $99.50. Battery kit, $5.37 extra.

RCA Model WF-16A (not illustrated). Has 10 sensitive tubes, 3 ranges to 200,000 counts per minute. Size, 11"x47/8"x7½". Weight 8 lbs. Original price, $750.00. McGee's Sale price, $149.50. Battery kit, $5.37 extra.

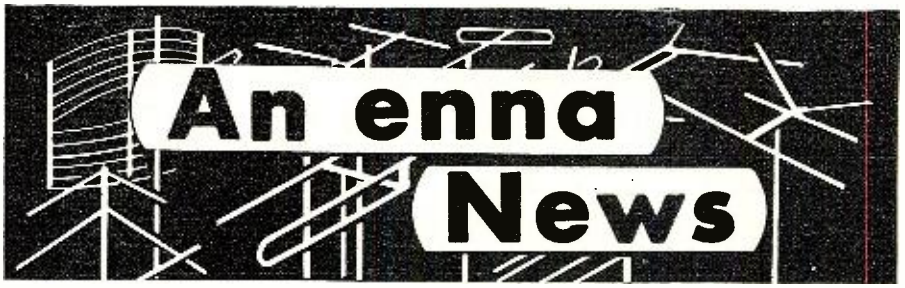
WF-10A

WF-12A

McGEE RADIO COMPANY

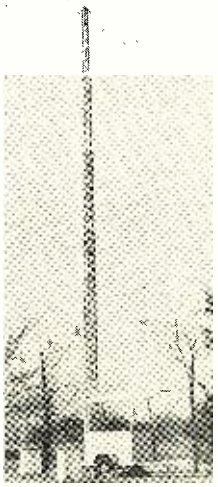
PRICES F.O.B. KANSAS CITY. SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 2-5092
1903 McGEE ST., KANSAS CITY, MISSOURI



SPAULDING "ERECT-TOWER"

Spaulding Products Company, 550 W. Barner St., Frankfort, Ind. has developed a new high-strength extruded aluminum telescoping tower which has been tradenamed "Erect-Tower."



Available in heights up to 100 feet, the tower features the same bridge-type construction as the firm's "X-Series." It is of all-riveted construction.

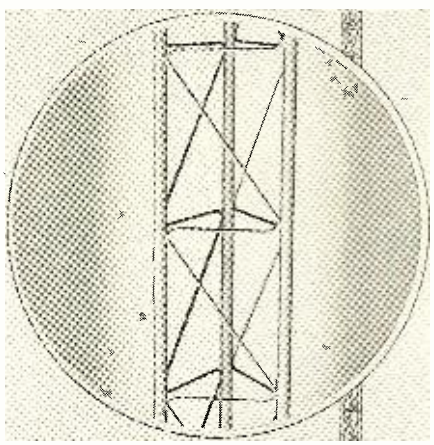
The special extrusion provides continuous low-friction track throughout the entire tower enabling a single man to crank the unit to an extended height. The geared winch assembly provides the tower with a self-locking feature at any height. The tower can also be motorized, if desired.

For emergency use, the company offers a compact trailer which provides a carriage for the tower. The enclosed-type trailer is water resistant so that the generator and radio equipment can be placed inside of it for rapid and safe transportation.

For full details on the "Erect-Tower," write the manufacturer direct.

NEW ROHN TOWER

Rohn Manufacturing Company, 116 Limestone, Bellevue, Peoria, Illinois



has recently added a new general-purpose tower to its line of antennas and accessories.

Designed for communication and TV applications, the No. 25 tower features a 12½" equilateral triangular design and utilizes special 1¼" extra-heavy-gauge tubing for side rails with "zig-zag" solid steel cross-bracing.

The tower is designed to be self-supporting up to 50 feet or it can be guyed for heights up to 150 feet. The towers are available in either hot-dipped galvanized or "RohnKote" enamel finish.

The company's representatives or the manufacturer itself can supply complete details on the No. 25.

WARD "SUPER 8"

Ward Products Corp., 1148 Euclid Ave., Cleveland 15, Ohio has just announced the availability of a new adjustable automobile antenna which is being marketed as the "Super 8."

The antenna features the company's "8-ball" mount which adjusts up to 35 degrees. The unit is triple chrome plated with four telescoping sections which extend to 57 inches.

Designed for easy, one-man installation from the outside, the "Super 8" has a 54-inch "Elektran" lead cable.

For additional information on this and other models in the firm's auto radio antenna line, write the manufacturer.

SATELLITE TRACKER

The Finney Company, 34 W. Interstate St., Bedford, Ohio has developed a high-gain FM antenna which peaks on 108-108.03 mc. for maximum reception of U. S. satellite signals.

This antenna, designated as the Model 108, has a professional counterpart, the Model 108 PRO, which has been cut especially for maximum sensitivity on 108-108.03 mc. The regular model will receive signals over the entire FM band while the Model 108 PRO is designed exclusively for satellite signal reception. This latter model can be stacked for greater power.

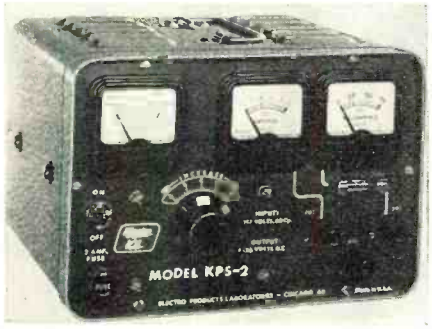
Those desiring further information on either or both of these specialized antennas should write direct to the manufacturer for details. —30—

What's New in Radio

D.C. POWER SUPPLY KIT

Electro Products Laboratories, 4500 N. Ravenswood Ave., Chicago 40, Ill. is offering a dual-purpose d.c. power supply kit which has been designated as the Model KPS-2.

Designed for servicing all transistor portable radios as well as the new 12-volt auto radio receivers, the unit provides two output ranges. Each range



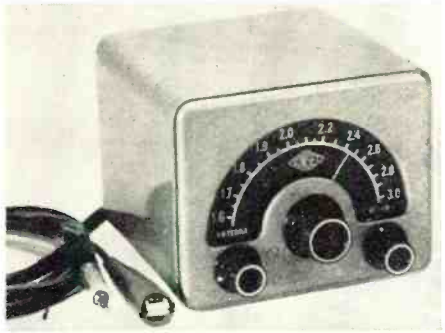
has its own output current meter and output terminals. The transistor radio output range is 0 to 20 volts at 75 ma. The 0-75 ma. meter for this range can detect minute variations in transistor current. An exposed, panel-mounted fuse in the secondary circuit provides transistor protection.

The auto radio output range is 0 to 16 volts at 5 amps. The current meter for this output has a range of 0 to 10 amperes.

The Model KPS-2 is also available completely assembled as the Model PS-2. Write the manufacturer direct for details on either or both of these units.

MARINE-POLICE CONVERTER

Gonset, 801 S. Main St., Burbank, Calif., has announced the availability of



a new marine converter for the mobile reception of maritime and police bands within the frequency range of 1.6 to 3 mc.

The Model 3163 provides coverage of such services as ship-to-ship, ship-to-shore telephone, marine weather, Coast Guard, and time signals, in addition to county and state police and amateurs.

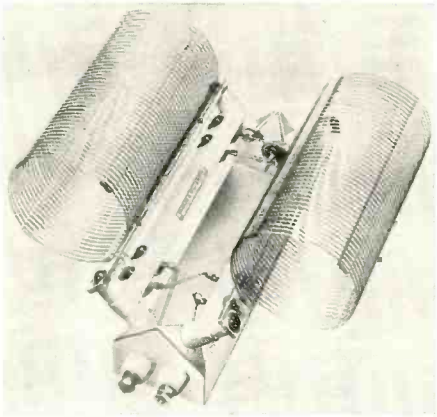
This new unit operates in conjunction with existing auto radios in any car having a 12-volt battery system. Installation is simple and rapid since it is unnecessary to alter the car radio in any manner. The converter is supplied with a cable and plug which fits into the antenna receptacle on the auto receiver. Operating voltage is readily obtained by clipping a lead to the accessory battery post behind the dash.

Optional selection of standard broadcast or short-wave reception is available at the flick of a switch. The unit measures 3½" high, 4" wide, and 4" deep.

B & W BALUN COIL KIT

Barker & Williamson, Inc., Canal St. and Beaver Dam Road, Bristol, Pa. is now offering a new balun coil kit which utilizes a single compact mounting bracket with coils mounted at 90 degrees.

Suitable for connecting either 75 ohms unbalanced to 300 ohms balanced or 75 ohms unbalanced to 75 ohms balanced, the kit comes complete with



all the necessary wiring instructions.

The air-wound bifilar coils are designed for operation on the 80 through 10 meter bands without tuning. The Model 3976 has a rating of 1 kw. on SSB, 500 watts on c.w., and 250 watts maximum AM phone. The coils (#3975) and mounting bracket (#3977) can be supplied separately if desired.

INTERMITTENT LOCATOR

General Cement Mfg. Co., 400 S. Wyman St., Rockford, Ill. is now offering a new chemical spray which helps to spot intermittent failure of circuit components caused by temperature change.

"Zero-Mist" reduces the temperature of the components sprayed. Trouble or failure often shows up under the resulting temperature difference. The new chemical is available in 16-ounce spray cans. For further information on this product, write the manufacturer direct.

SYNC STABILIZING POT

Bourns Laboratories, Inc., P.O. Box 2112, Riverside, Calif. is now marketing a new type of commercial poten-

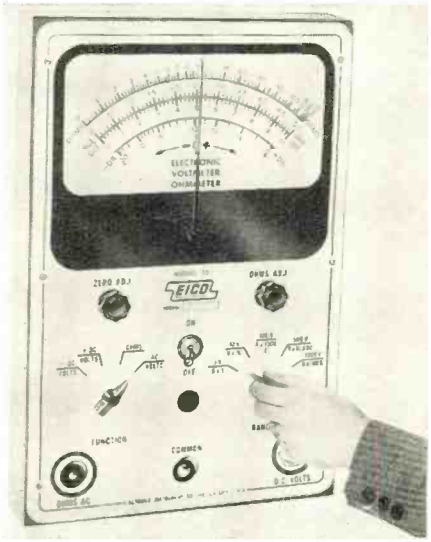
tiometer which is said to speed TV servicing time and eliminate callbacks due to instability of sync in hold circuits.

The "Trimit" provides at least six full turns of shaft rotation between out-of-sync points. A self-locking shaft prevents any shift in settings during handling or transport of the receiver.

The new unit is being offered in a special introductory kit which contains an assortment of five carbon elements of the most common resistance values, five clip-on adapters which fit chassis holes, and a detailed illustrated instruction sheet.

VISUAL TRAINING AID

Electronic Instrument Co. Inc., 33-00 Northern Blvd., Long Island City 1, N. Y. has developed a v.t.v.m. dy-



namic demonstrator designed especially to help instructors teach students the operation of a vacuum-tube voltmeter.

Using the EICO #221 as the model, a giant 13" meter scale makes for easy classroom viewing. The demonstrator measures 14¾" wide, 23" high, and 3½" deep and can be placed on a desk

48¢ ea. for any tube

$45.00 Per Hundred

STANDARD LINE ELECTRIC COMPANY

FREE POSTAGE IN U.S.A. & TERRITORIES

FREE TUBE BRIGHTENER ON ORDERS OF $10.00 OR MORE

ANNOUNCING OUR NEW PRICE SCHEDULE

Effective July 25, 1958 all tubes (Radio & Television receiving) will be sold and shipped at the fantastic price of only .48c ea. or $45.00 per hundred. Any "on hand" orders at that time will receive credit for future purchases.

THE TUBES ADVERTISED HEREIN ARE NOT NECESSARILY NEW TUBES BUT MAY BE ELECTRICALLY PERFECT FACTORY SECONDS OR USED TUBES AND ARE SO MARKED

All TV & Radio Tubes are tested by our supplier under actual conditions in Radio & TV chassis or in Hickock Tube Testers Model 533A.

And, of course, the famous Standard Line guarantee remains in effect: All tubes guaranteed to be replaced free if they fail to function efficiently within one year's time. (defective tubes must be returned intact, postage paid. Refunds will be cheerfully made within five (5) days if not completely satisfied.)

0B2	3AL5	5V6GT	6BE6	6S4	7F7	12Q7	32L7GT
0Z4	3AU6	5W4GT	6BF5	6S8GT	7F8	12SA7	35/51
1A5GT	3AV6	5X4G	6BG6G	6SA7	7G7	12SG7	35A5
1A7GT	3BA6	5X8	6BH6	6SB7Y	7H7	12SJ7	35B5
1B3GT	3BC5	5Y3GT	6BH8	6SC7	7J7	12SK7	35C5
1C5GT	3BE6	5Y4G	6BJ6	6SF5	7K7	12SN7GT	35L6GT
1C6	3BN6	5Z3	6BK5	6SF76SG7	7L7	12SQ7	35W4
1C7	3BU8	5Z4	6BK7	6SH7	7N7	12SR7	35Y4
1H4G	3BY6	6A8	6BL7GT	6SJ7	7Q7	12V6GT	35Z4GT
1H5GT	3BZ6	6AB4	6BN6	6SK7	7R7	12W6GT	35Z5GT
1L6	3C2	6AC7	6BQ6GT	6SL7GT	7S7	12X4	#37
1LA4	3CB6	6AF4	6BQ7	6SN7GT	7V7	12Z3	#39/44
1LA6	3CF6	6AG5	6BR8	6SQ7	7W7	14A7	#41
1LB4	3CS6	6AG7	6BS8	6SR7	7X6	14AF7	#42
1LC5	3DT6	6AH4GT	6BY5G	6T4	7X7	14B6	#43
1LC6	3Q4	6AH6	6BZ6	6T8	7Y4	14F7	#45
1LH4	3Q5GT	6AK5	6BZ7	6U4GT	7Z4	14F8	#47
1LN5	3S4	6AK6	6C4	6U5	8AW8	14H7	50A5
1N5GT	3V4	6AL5	6C5	6U8	12A8	14N7	50B5
1P5GT	4BC8	6AL7GT	6C8S	6V3	12AB5	14Q7	50C5
1Q5GT	4BQ7A	6AM8	6CB6	6V6GT	12AQ5	14S7	50C6G
1R5	4B58	6AN8	6CD6G	6W4GT	12AT6	17AX4GT	50L6GT
1S5	4BU8	6AQ5	6CF6	6W6GT	12AT7	17DQ6	50Y6
1T4	4BZ7	6AQ6	6CG7	6X4	12AU6	19AU4	50Y7
1T5GT	4CB6	6AQ7GT	6CG8	6X5GT	12AU7	19BG6G	#57
1U4	5AM8	6AR5	6CH8	6X8	12AV6	19C8	#58
1U5	5AN8	6AS5	6CL6	6Y6G	12AV7	19J6	#80
1V	5AQ5	6AS8	6CM6	7A4	12AX4GT	19T8	#81
1V2	5AS8	6AT6	6CM7	7A5	12AX7	19X8	117L7GT
1X2	5AT8	6AU4GT	6CN7	7A6	12AZ7	25AC5	117N7GT
2A3	5AV8	6AU5GT	6CU6	7A7	12B4	25AV5GT	117P7GT
2A5	5AW4	6AU6	6DG6	7A8	12BA6	25AX4GT	117Z3
2A7	5AZ4	6AU8	6DQ6	7B4	12BE6	25BK5	117Z4GT
2AF4A	5BK7	6AV5GT	6DT6	7B5	12BF6	25BQ6	117Z6GT
2B7	5BR8	6AV6	6E5	7B6	12BH7	25CD6G	807
2BN4	5BQ7	6AW8	6H6	7B7	12BK5	25CU6	9002
2D21	5BZ7	6AX4GT	6J4	7B8	12BQ6	25L6GT	9003
2E5	5CG8	6AX5GT	6J5	7C4	12BR7	25W4GT	9006
2X2A	5J6	6AZ8	6J6	7C5	12CA5	25Z5	
3A2	5T8	6BA6	6K6GT	7C6	12CU6	25Z6	
3A3	5U8	6BC5	6K7	7C7	12DQ6	#27	
3A4	5U4G	6BC8	6L6	7E6	12J5	#30	
3A5	5V4G	6BD6	6L7	7E7	12L6GT	#31	

ALL RECEIVING TUBES SENT POSTAGE PAID.

Please send 25c handling for orders under $5.00 Send 25% deposit on C.O.D. orders and please send approximate postage on Canadian and foreign orders.

Above is only a partial list — order any type at the same price or send for free tube list and order blank. We have over 5,000 tube types on hand or at easy access, including special purpose, industrial and transmitting tubes which are slightly higher.

ALL TUBES GUARANTEED ONE FULL YEAR...

NOTE: When ordering receiving tubes be sure to enclose 48c for each tube or $45.00 per hundred.

Thousands of TRADE-IN TVs

Please Specify Console or Table Model When Ordering

Reconditioned By Factory Trained Technicians! Guaranteed To Be In Working Condition When You Receive Them!

10"	$25.00	19"	$56.00
12"	$30.00	20"	$63.00
14"	$35.00	21"	$70.00
16"	$42.00	24" (when available)	$95.00
17"	$49.00	27"	$129.00

Get yourself a second set or buy some for re-sale!

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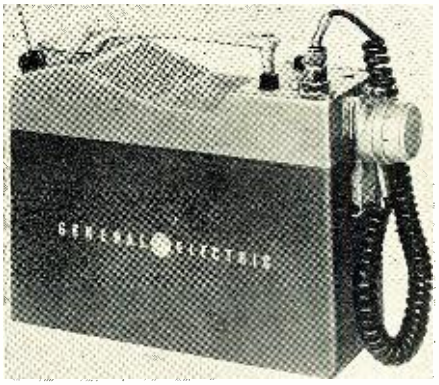
or mounted on a wall. The unit is constructed of steel with an aluminum panel. The company has set a special price on this demonstrator for teachers.

TRANSISTORIZED TWO-WAY UNIT

The Communication Products Department, *General Electric Company,* Syracuse, N. Y. has announced its entrance into the hand-carried, two-way radio market with a transistorized portable transmitter-receiver unit.

Designed for operation on the 25-54 mc. and 144-174 mc. bands, the former unit uses the *G-E* 3N36 transistor while the higher frequency unit employs the 3N37 transistor—units engineered to operate at frequencies up to 100 mc. and 200 mc. respectively.

The first unit off the production line will be the portable for 25-54 mc. service. Sensitivity is .4 microvolt which makes the transmitter-receiver suitable for use in buildings as well as outdoors. Modular construction has been used in the transmitter section, making replacement simple. The transistors are of the plug-in type and may be removed without unsoldering. All tuning points and components are readily accessible for servicing.



MARINE RADIOTELEPHONE

Kaar Engineering Corporation, 2945 Middlefield Road, Palo Alto, Calif. is currently introducing a deluxe 55-watt, 5-channel radiotelephone for marine applications.

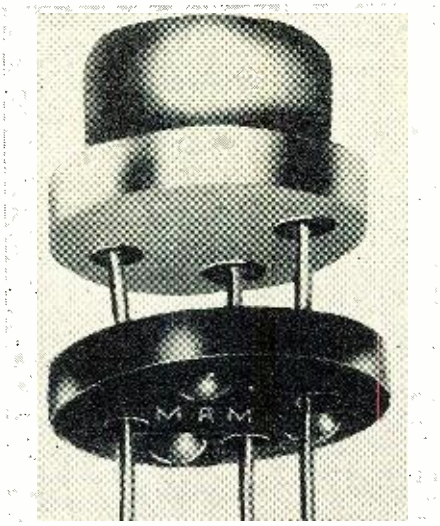
Suitable for operation from 6-, 12-, or 32-volt d.c. or 117-volt a.c. power sources, the new unit generates 28 watts r.f. output and meets government regulations for commercial craft carrying six or more passengers. Broadcast-band reception is included. Automatic noise limiting, a pi-output network, and new speech clipper and filter are among its technical features for greater voice output.

The set can be table-top or bulkhead mounted. Both cabinet and chassis are protected with new corrosion-resistant materials. The cabinet is finished in driftwood grey with a charcoal grille and hood.

"TRANSIPAD"

Milton Ross Metals Company, Davisville Road, Bucks County, Southampton, Pa. has developed a new device which simplifies the installation and permits a more reliable mounting for transistors on printed circuit boards.

Known as "Transipad," the unit was designed especially for JETEC 30



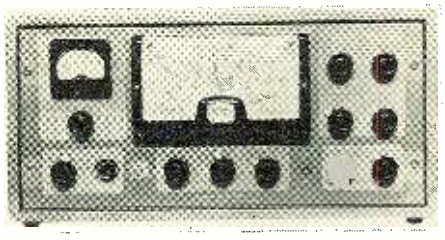
transistors. It consists of a glass-filled Diallyl Phthalate wafer with three holes and three hemispherical feet. The transistor leads pass through the holes to the circuit board solder connections and the transistor rests directly on the "Transipad." This eliminates the necessity for using the leads as supports and permits a lower, more stable mounting with positive insulation between the transistor case and the printed circuit conductors.

The hemispherical feet raise the unit off the board, allowing flow clearance for solder fillets and permitting air to circulate between the board and the holder.

IMPORTED HAM GEAR

American Geloso Electronics Inc., 312 Seventh Ave., New York 1, N. Y. is now offering a ham transmitter and receiver, made in Milan by *Societa per Azioni Geloso,* to the American amateur market.

The transmitter is designated as Model G-212-TR while the companion receiver is known as the G-209R. Both units feature heavy chassis construction, oversize components, frequency stability, accurate calibration, and



power supplies adjustable from 110 through 280 volts. With many homes equipped for 220-volt service, the company suggests 220-volt operation to reduce line-losses.

The 60-watt transmitter (above) switches from 10 through 80 meters, has self-contained dual power supplies, choice of c.w. or phone, and a pi-network to work into all standard amateur-band antennas.

Write the U. S. distributor for full details on this gear. —30—

"Sound" Advice for TV

(*Continued from page 38*)

plaint may indicate that the set acts as a fine sonic detector for tracking the progress of the neighbor's car down the street, in terms of the ignition noise that is picked up, although sound is clear. Or else, in a similar way, the sound system lets the customer know every time the neighbor uses the vacuum cleaner. In such cases especially, the primary of the ratio detector should be checked and adjusted first. Here's how:

1. Rock the ratio-detector *secondary* slug from the "good sound" position to the "good noise rejection" position. If these positions coincide, the primary is in correct alignment. If they do not, make note of how far apart they are, in terms of amount of rotation of the secondary.

2. Rotate the primary slug half a turn clockwise.

3. Now swing the secondary adjustment again between the "good sound" and "good noise rejection" positions, as was done in step 1. This time note whether these two positions have moved farther apart or closer together.

4. If the two settings just noted have moved closer together, keep repeating steps 1, 2, and 3 until you have found the *primary* setting that produces good sound and good AM rejection at the same point of adjustment on the *secondary*. If the two settings have moved farther apart, you are headed in the wrong direction. Reversing to counterclockwise rotation of the primary, go through steps 1, 2, and 3 until you find the primary setting that makes good sound and good noise rejection coincide on the secondary.

5. Check the adjustment of the sound take-off coil. If this is off tune, electrical noise may appear in the sound on a weak signal even when the detector stage is aligned properly.

You may need a source of noise in order to make the adjustments just noted. It might be helpful to leave your truck idling outside the house to provide a steady source of ignition noise. You also might try fine-tuning "into the sound" to increase the level of buzz. An electric shaver, plugged into an outlet on the same line as the TV set, also makes a good noise generator.

Quadrature Detectors

When aligning a sound strip using a quadrature type of sound detector (6BN6, 6DT6, etc.), the signal input to the set must be reduced until the sound is below the limiting level of the stage. To achieve this condition, loosely couple or entirely disconnect the antenna, if necessary. However, when making the final adjustment to the "anti-buzz" control, which adjusts bias of the stage, a full signal should be applied.

—30—

Sound on Tape

By BERT WHYTE

EVENTS move so swiftly in the world of stereo that what was rumor yesterday, has become fact today. Or so it would seem! I have been reporting to you on the fascinating possibilities of the new "4-channel or half-track stereo" that *RCA* and *Shure Bros.* have shown in *laboratory* form. If all works as intended, it would appear to be the answer to low-cost stereo tape. I stressed the term "laboratory" for it was certainly no further in development a few months ago. Let us say that it was in the category of "vast potential—better watch closely—but don't expect much very soon." Having thus neatly filed this information, the next day's mail brought an announcement and accompanying photos of the new "4-channel A series—tape machine" from *Ampex!*

Yessir, the animal has crept right up on us and is right out in plain commercial sight! Basically, the new machine looks just like the familiar *Ampex* A series unit. This new job differs in having a protruding control lever mounted behind the plastic head cover and a spring-tensioned tape-arm Microswitch affording automatic tape motor cut-off. The function of the lever is to change the tape head configuration. With the lever in the "up" position, tracks 1 and 3 of a 4-channel stereo tape are reproduced. When all the tape has run through the head gate in the one direction the automatic cut-off switch functions, the tape is turned over without rewinding and now tracks 2 and 4 are reproduced. By placing the head lever in the "down" position the normal present-day two-channel stereo tapes can be reproduced. The unit will also reproduce half- and full-track monaural recordings when the lever is in the "down" position and will record half-track monaural in this mode.

This is truly a "universal" machine which *Ampex* dubs as the "Universal A 900" series. And the cost, friends? Not a dime over the price of the current two-channel machine! And now to quickly allay the moans of those who own the present type of *Ampex* stereo . . . you are not threatened with obsolescence. Very prudently *Ampex* has made available a conversion kit which will enable you to change over to the new heads. The kit is simple and easy to install and is to be priced at less than 70 dollars. The only thing not furnished, because of construction problems in the older machines, is the automatic tape cut-off. But this is a minor matter and should cause no undue hardship. Now the significant thing about these new units is that they are not figments of *Ampexes'* imagination. All *Ampex* stereo A series equipment, whether it is the straight "deck" or elaborate console, is now being shipped from the factory with the "universal" heads and cut-off.

By now some of you sharp people have noticed that I did not mention the new "magazine" or "cartridge" in connection with this new *Ampex* machine. The answer is that there isn't any . . . and herein lies a little behind-the-scenes tale. It seems there has been quite a lot of dissension among 4-channel manufacturing companies regarding the adoption of a standard 4-channel head configuration. The advocates of the magazine-load 4-channel machines were at odds with the advocates of the "straight" or normal reel type 4-channel machine. That omnipresent word "compatibility" was tossed around. Finally it appeared that there wasn't really anything to fight about, because one of the parties (who shall remain nameless) had made a "boo-boo" in some measurements of proposed heads and this was the innocent bone of contention. Thus we shall have compatibility of a sort . . . in other words the new 4-channel heads will also play the present 2-channel stereo tapes . . . but there does not appear to be any practical method of converting present stereo machines to the magazine-load type of operation. So we can look forward to new machines of this *Ampex* type and conversion kits for other machines and to brand-new units featuring magazine-load stereo. This obviously means that 4-channel stereo tapes will appear in the regular reel form and in magazines.

Now to anticipate your questions of "OK so we have 4-channel machines . . . where are the 4-channel tapes?" *Ampex* is busy readying special 4-channel heads for its standard dubbing machines and they are on order by many recording companies. One of the big companies already has its dubbing channel and has been turning out experimental batches of 4-channel tapes. By the time you read this, the first commercial 4-channel stereo tapes will have appeared on the market. They will be of the normal reel type as well as the magazine type. (See Editor's Note below as well as pages 8 and 80.) I have been told that the quality of the new 4-channel stereo at 3¾ ips, with very narrow gap heads and special equalization, is at least equivalent to present 7½ ips tapes. If by "quality" they mean frequency response and distortion characteristics I can believe they have approached the figures for 7½ ips tapes. In terms of signal-to-noise ratio or tape hiss, I'll be a "doubting Thomas" on this score, until I have a chance to hear the tapes on the proper equipment.

At any rate, this is a tremendous step forward for tape stereo, meaning as it does the coming of low-priced stereo tapes which can be competitive with disc stereo. It is generally felt that the public will soon be able to buy an hour's worth of stereo tape for less than 6 dollars. This, plus the stereo disc, will set off a hi-fi boom that is certain to shatter all records and all pre-conceived notions of how big a music market exists in this country.

(Editor's Note: As we go to press, *RCA* has announced the release of over thirty stereotape cartridges along with two special tape machines that will play these cartridges. The plastic packets, which measure 7" x 5" x ½", contain up to an hour of music and will retail from $4.95 to $9.95. The quarter-inch tape used has four sound tracks and operates at a speed of 3¾ ips. The tape travels for about half an hour from the left spindle to the right, using two of the sound tracks. Then it reverses and plays the other half from right to left, leaving the tape contents of the cartridge rewound and ready for replaying.)

CHADWICK

SYMPHONIC SKETCHES

Eastman Rochester Symphony Orchestra conducted by Howard Hanson. Mercury MDS5-24. Price $12.95.

Chadwick was one of the "founding fathers" of American music, coming to a certain prominence in the 1880's. But like so many other composers, today his works are little known and about all we have of his that is even remotely familiar is the "Jubilee" section of his "Symphonic Sketches."

Now *Mercury* has resurrected the complete "Sketches" and one is most pleasantly surprised at the wealth of genuine musical talent in the work. The spritely "Jubilee" begins the work and then gives way to a very lovely and evocative quiet movement entitled "Noel." Then comes a very gay and rollicking scherzo aptly called "Hobgoblin." There are some fine brass and percussion passages of considerable power here. The final section is rather a startling change of mood from what has preceded. Entitled "A Vagrom Ballad," this is music taut and tense, powerfully satiric and perhaps even a little grim. The scoring here is rich and effective, again with plenteous brass and percussion.

The sound throughout this tape is

quite stunning, one of the best stereos available. The directionality was nigh perfect with instrumental positioning very easy to distinguish. The three track technique afforded fine center "fill" here and gave the impression of a completely homogeneous orchestral sound.

Dynamics here are ultra-wide so caution is urged in your initial volume settings. Howard Hanson, as always with this type of music, has all elements perfectly co-ordinated and his performance is brisk and unflagging. Under his urgings the orchestra delivers playing characterized by spirit and precision.

BEETHOVEN
SYMPHONY #3 (EROICA)
Philharmonic Promenade Orchestra of London conducted by Sir Adrian Boult. Vanguard VRT4003. Price $14.95.

To *Vanguard* goes the honor of producing the first stereo tape of Beethoven's great "Eroica" and a stellar job they have done. Here *Vanguard* has managed something which is quite difficult . . . a recording which has good clean detail and forcefulness of projection, with a most salutary acoustic perspective which affords a most pervasive sense of "naturalness." All the stereo attributes are here . . . direction is easy to discern, instrumental separation is distinct, and the feeling of depth is well maintained. Dynamic expression is wide in compass but there is never a sense of strain or of striving for "effects." The over-all musical balance is superb and while you expect stereo to aid in the realism of the big climaxes, it is in some of the very pianissimo sections that the feeling of "on-the-spot-presence" is most pronounced.

Sir Adrian turns in what can only be termed a surprising performance since Beethoven is not supposed to be one of his strong points. Here he seems thoroughly at home with the score and his performance must be judged "excellent" by any standard. It is true he doesn't do any "heaven-storming" or make of it the passionate utterance it has become in the hands of Beethoven masters like Klemperer or Toscanini. But his tempi are judicious, his phrasing neat and expressive, his dynamics wide but not overblown, and in an over-all view it must be said that he has managed to convey a good idea of the drama in the score.

Actually, in the rich sonic atmosphere of stereo, this sounds more like a concert hall performance and carries with it more of that conviction than any of the disc recordings I have ever heard. To be sure there will be other recordings of the "Eroica" forthcoming in the stereo medium which may have the combination of sonic splendor and performance that will dim the luster of this tape, but if you are particularly addicted to this work and would rather not wait for the possibility of something superior, I don't think you will be unhappy with this recording. —30—

The Multi-Dipper

(*Continued from page 62*)

Dipper may be used as a field strength meter. An adapter may be constructed with a 4-pin socket and plug to provide for quick addition of an antenna.

With headphones connected and with the oscillator non-operative the Multi-Dipper makes a good phone monitor. Switch S_1 should be closed, shorting out the meter.

Accessories

By means of adapters the Multi-Dipper is made to serve several useful purposes not ordinarily associated with a grid-dip meter. Fig. 7 shows the wiring to be made on 4-prong plugs, which are inserted in the coil socket. Fig. 5 shows the actual construction of several of these items.

When a resistor is placed across the oscillator terminals in place of a coil, the circuit becomes a multivibrator and produces square pulses with a short rise time. The probe shown in Fig. 7A makes use of this fact to produce a signal rich in harmonics to around 10 mc. This signal may be injected into any signal circuit of a radio or audio amplifier to produce an audible output with a musical tone. Using the signal injector, it is possible to rapidly check the location of trouble in a radio receiver by determining the point where the signal is not passed. Where an exact frequency setting is not required, the signal injector may be used as a signal source in the rapid alignment of r.f. and i.f. amplifiers. A 100,000-ohm resistor was found to give the best results with the 6BG7 or 6BF7W. The best value to use with a 6J6 is 1 megohm. The strongest signal will be produced when the oscillator voltage is increased to maximum and capacitor C_1 is at maximum capacity.

Another useful test instrument is the signal tracer, which allows a signal to be followed through a receiver from the antenna to the audio stage. The probe shown in Fig. 7B converts the crystal voltmeter into a shunt diode detector to be used for signal tracing. This may be used with headphones for audible detection of signals. Normally the meter should be shorted out by means of S_1 unless a visual indication of signal strength is desired. Care must be taken to avoid excessive signals which might damage the meter.

The gadget shown in Fig. 7C is a neutralizing probe. It consists of a two-turn, ¾-inch diameter, insulated coil connected to the diode voltmeter through a plug and several feet of coaxial cable. For convenience the pickup loop should be mounted on the end of an insulated rod. This probe may be inserted in the plate tank circuit of an r.f. power amplifier when making neutralization adjustments. It is much more sensitive for this purpose than the lamp which is ordinarily

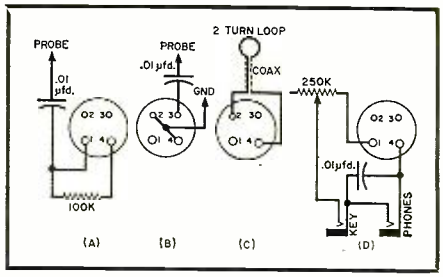


Fig. 7. Accessories for the Multi-Dipper. (A) Multivibrator signal injector probe. (B) Signal tracer probe. (C) Neutralizing indicator probe. (D) Optional code practice oscillator attachment for unit.

used. The neutralizing probe may also be used to detect r.f. leaks in shielding, standing waves on r.f. transmission lines, stray fields, etc.

Fig. 7D shows a circuit which may be used as a code practice oscillator. Use is again made of the multivibrator principle. However, the inductance of the headphones may be great enough to oscillate at an audible frequency. The 0.01 μfd. capacitor helps to tune the headset inductance and also helps to give a "clean" tone. A wide variation in tone is obtained through the use of a 250,000-ohm potentiometer in series with the headset.

Access may be had to the microammeter itself through pins 3 and 4 of the coil socket. With suitable shunts or series resistors the meter may be used as a d.c. milliammeter or voltmeter.

Other applications of the Multi-Dipper may suggest themselves to the experimenter. The properties of the two-terminal oscillator are such as to have wide application. Almost any air-core or iron-core inductor will oscillate in the circuit. The r.f. voltmeter portion of the circuit also has many uses. The entire set may even be used as a crystal broadcast receiver. —30—

ANCHORING A BUG

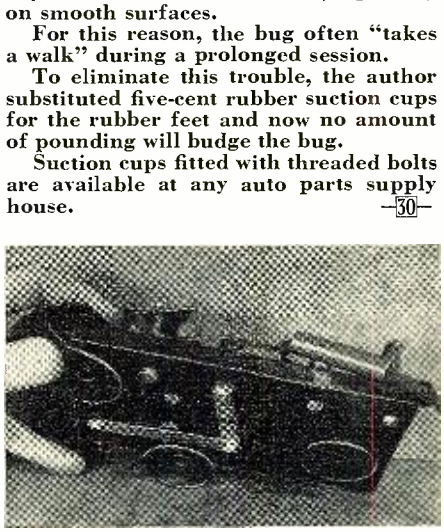
By PETER BARNA

BRASS pounders who really pound their bugs may find the rubber feet on the keys offer insufficient friction, especially on smooth surfaces.

For this reason, the bug often "takes a walk" during a prolonged session.

To eliminate this trouble, the author substituted five-cent rubber suction cups for the rubber feet and now no amount of pounding will budge the bug.

Suction cups fitted with threaded bolts are available at any auto parts supply house. —30—



Mac's Service Shop

(*Continued from page 58*)

the packaged printed circuits you find in the second detector circuits of radios, the sync circuits of TV sets, and so on. Each little flat plate has four leads coming out of it and by using two of these leads for terminals and soldering other leads together or cutting them off as directed, you can get several different values of capacitance from each unit."

"I see you've got three UGA-1, three UGA-2, three UHK-1, and three UHK-2 units," Barney remarked. "What's the difference?"

The UGA units are general application types with a capacity tolerance of ±20%. You can choose 12 values of capacitance between .0004 and .0013 μfd. with the UGA-1. The UGA-2 covers from .0006 to .0027 in 15 steps. Some values duplicate those of the UGA-1 unit. UHK units are of the 'High-K' minimum-rated-capacitance type. UHK-1 covers from .001 to .004 in 7 steps. UHK-2 goes from .0025 to .015 in 8 steps. All units are rated at 500 working volts."

"How would you go about using them?"

"For replacing those odd values of capacitance we run into every now and then in our servicing of TV sets and electronic control and measurement equipment. In spite of our attempts to keep a pretty good stock of ceramic and mica capacitors, there often is an in-between value we need and do not have. On top of that, now and then we run out of a regular value. This versatile little group of capacitors will take care of both cases. Because of their added cost, it would be foolish to use them for regular replacement of conventional-value capacitors. But having them on hand will allow us to stock just the popular values and to fall back on this kit for the odd-ball values we get a call for once or twice a year."

"That makes good sense to me," Barney observed. "They will do the same thing for us in capacitors that *Mallory's* 'Yard-Ohm' kits do for us in resistance. Anything that relieves the shop of the need for carrying a large stock of slow-moving items ought to be a good investment."

Mac looked at his youthful assistant long and quizzically.

"Flamehead," he finally said, "that's twice in the last half hour you've said something that sounds as though you've been thinking about the service *business* instead of just service work. That's not like you at all. You feel all right?"

"OK, OK, lay off!" Barney said gruffly as he slipped into his shop coat. "Don't you suppose a guy ever grows up? You'd be surprised what I think about sometimes."

"Yes," Mac said with a slow grin as he placed an affectionate hand on the youth's shoulder, "I'll bet I would; I'll bet I would!"

—30—

Use Shunt Feed

(*Continued from page 47*)

Since the shunt-fed class B plate modulator worked so successfully, the author decided to apply the shunt-feed system to a choke-coupled (Heising) modulator for a low-power transmitter. The usual problem in Heising modulation is that of having to reduce the plate voltage on the modulated r.f. amplifier in order to achieve 100% modulation. Heising modulation is the oldest system of plate modulation and usually consists of a class A audio amplifier coupled to the r.f. amplifier by means of a modulation choke coil, as shown in Fig. 3. The d.c. plate voltage and plate current in the r.f. amplifier must be adjusted to a value which will cause the plate impedance to match the output of the modulator since the modulation choke gives a 1-to-1 coupling ratio. In choke-coupled modulators, the output peak voltage of the modulator must be such that the a.f. voltage on the plate of the amplifier is equal to the d.c. plate voltage on the r.f. amplifier if 100% modulation is to be obtained. Then the r.f. output will fluctuate between twice the unmodulated r.f. voltage and zero. To obtain 100% modulation, *i.e.*, in order that the peak a.f. voltage developed across the choke shall be equal to the d.c. voltage on the amplifier tube, it is necessary that the voltage on the r.f. amplifier plate be reduced from that on the modulator tube by means of a resistor (R) as shown in Fig. 3. Capacitor C in Fig. 3 is used to bypass the audio frequencies around R. This type of modulator is rarely used except for very low power sets of the portable type. A higher degree of distortion can be tolerated in low-power emergency phone transmitters using pentode modulator tubes so the series resistor and bypass capacitor are usually omitted in such transmitters.

Fig. 4 shows the shunt-feed system as applied to choke-coupled modulation. If the final amplifier tube of the r.f. section has been decided upon, the normal plate voltage can be determined as well as the plate current. Simple calculations will give us the r.f. amplifier plate impedance and the amount of audio required for 100% modulation. Since the arrangement shown will give a 1-to-1 coupling ratio, the tube selected for the class A amplifier modulator should be capable of delivering the necessary audio at the same plate impedance as the final amplifier. As stated previously, the a.f. voltage on the plate of the modulator tube should swing to a point equal to the d.c. plate voltage on the r.f. amplifier for 100% modulation. In Fig. 4, in order to accomplish 100% modulation, the plate voltage on the modulator should be somewhat higher than the d.c. applied to the r.f. amplifier.

The author applied the shunt-feed system to a very low power 29 mc. transmitter to determine its effectiveness. The results were most gratifying. The input to the final amplifier in this small transmitter is 1.08 watts. Allowing for circuit losses, it was determined that about 0.6 watt of audio would be required to adequately modulate the amplifier. It didn't take long in checking the available tube manuals and charts to come up with a suitable class A amplifier. A 6AK6 with 135 volts on the plate delivers 0.6 watt of audio with a load resistance of 12,000 ohms. The subminiature tube in the final runs full power with 120 volts at 9 ma. on the plate. The impedance mismatch is negligible. Reports received from local stations are gratifying. Every station worked has commented upon the excellence of the modulation voice quality as well as percentage. More often the comment is that the rig is the best sounding low-power transmitter that has been heard. The results around the Washington, D. C. area have been most satisfying to the author who now plans to utilize the flea-power transmitter for portable operation.

It is hoped that this review of shunt feed of audio may be of assistance in expanding your approach to plate modulation of your present transmitter or the new one that you may be planning. The shunt-feed system may save money in that you may already have, in your junkbox, the necessary components for modulating that low- or high-power rig effectively and at less cost to you. Try it and be pleasantly surprised! —30—

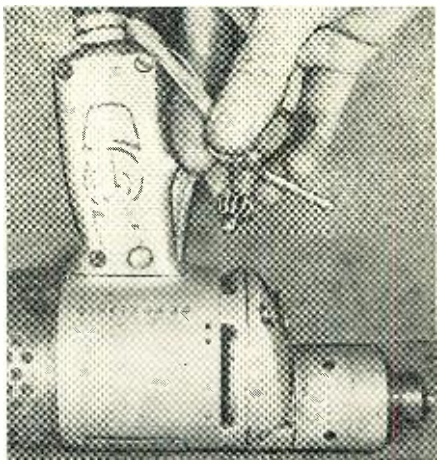
ANCHOR CHUCK KEY

By PETER BARNA

HAVING tired of always looking for my chuck key, I wrapped a heavy elastic band around the power cord close to the drill handle, then tied a short, stout string to the chuck key and the loose end of the elastic.

When in use the elastic allows enough stretch to tighten the chuck, meanwhile keeping the key well out of the way when not needed. The length of the string will be determined by the size of the drill and the stretch of the elastic used. —30—

Use elastic to keep chuck key anchored.



CIRCUITRY CROSSWORD

By **JOHN A. COMSTOCK**

HERE'S a little teaser to try during the coffee break at the shop. All you active radio and TV technicians should be able to bat this out in record time—but watch out for a couple of tricky definitions—they are lurking!

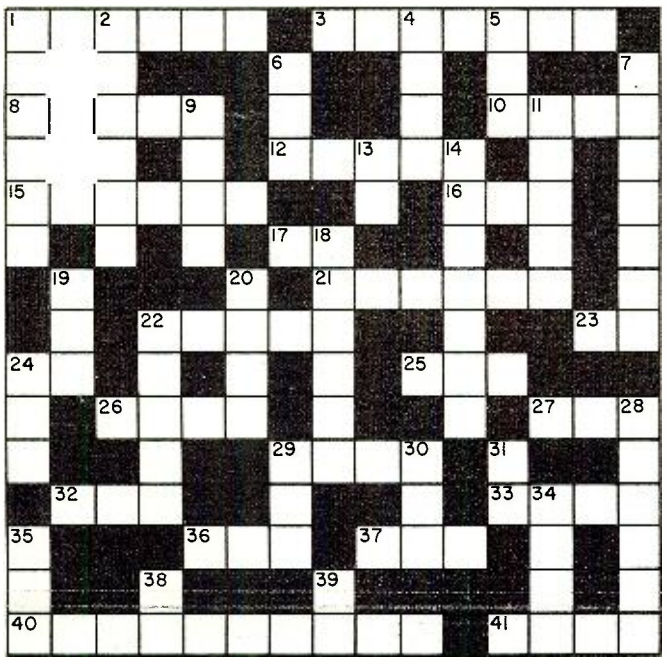
(*Solution on page* 129)

ACROSS

1. Color in TV.
3. One type of TV transformer.
8. Solder ingredient.
10. Most speakers have one.
12. Selector for TV or FM.
15. Found in phono pickups or on meter faces.
16. Receives or radiates r.f. (Abbr.)
17. Small amount of current. (Abbr.)
21. Intelligence in electronics.
22. Voltage that provides scan.
23. Inert-gas tube. (Abbr.)
24. Tube-type suffix. (Abbr.)
25. Record players may produce this.
26. Tip of a test lead.
27. One of the color TV phosphors.
29. Specific length of transmission line, often used for matching.
32. Characteristic that distinguishes 27 Across from other colors.
33. Meter with high input impedance.
36. Combination circuit. (Abbr.)
37. Hartley or Colpitts. (Abbr.)
40. Pattern to check linearity or convergence.
41. Common transducer. (Abbr.)

DOWN

1. Visible electrical discharge.
2. Lots of lines but no picture.
4. Output device for sweep circuits.
5. Works on TV r.f. and i.f. grids. (Abbr.)
6. Alternate to 40 Across.
7. Synonym for 3 Across.
9. Zero reading.
11. Type of tube base.
13. Designation on tube basing diagram. (Abbr.)
14. Some color generators produce this.
18. ——— ratio.
19. One in every TV set.
20. May connect to test probe or circuit component.
22. An abrupt flow of heavy current.
24. A color CRT has more than one.
28. Makes for a "clean sweep."
29. Complement of equipment.
30. For grounding or traveling.
31. Over 40 million homes enjoy this. (Abbr.)
34. Eliminates unwanted frequencies.
35. Controls signal strength in radio. (Abbr.)
38. Found in tube manual along with 13 Down. (Abbr.)
39. Not a gas tube. (Abbr.)



Tape Preamp

(Continued from page 48)

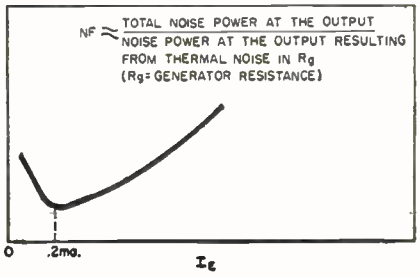
Thus the input resistance would be in the range of 2000 to 10,000 ohms with a bias for low transistor noise. The transistor is operated in the common-emitter configuration since we are interested in maximum power gain. Fig. 4 indicates the impedances available in commercial tape heads currently on the market. Now we want to choose a head impedance that will most nearly match the transistor input impedance at the frequency where the signal-to-noise ratio is most critical. It so happens that for the hybrid circuit this occurs at the low-frequency end of the audio spectrum. From Fig. 4 we see that the higher impedance head will be a closer match at 50 cycles for a transistor input resistance of 2000 to 10,000 ohms. This arrangement gives maximum power transfer in the middle of the audio range. At 50 and 15,000 cps, the mismatch is about the same degree, giving a nearly equal signal-to-noise ratio at both frequencies. This response can be seen in the lower curve of Fig. 7.

Transistor-Tube Preamp

Fig. 6 is the hybrid preamplifier circuit that was developed after taking into consideration all of the points discussed thus far. The 2N508 transistor is biased at approximately .5 ma. from a constant-current source for good current stability with temperature and transistor interchangeability. R_2 biases the base for the desired collector-to-emitter voltage and since this bias is taken from the collector, the d.c. feedback helps to keep the collector-to-emitter voltage in the range of 1.5 to 4.5 volts. This voltage varies with the leakage current of C_2 and with h_{FE} (d.c. current gain) for different transistors. This range of V_{CE} bias has little effect on the operation of the preamplifier. R_3 in conjunction with C_3 improves the signal-to-noise ratio of the transistor stage by reducing the gain by means of increased degeneration below 50 cps. R_3 also improves the fidelity and frequency response slightly. R_4 cannot be made larger without further degrading the high-frequency response. The loss in gain results from the transistor collector-to-emitter capacity shunting R_4.

Fig. 5 is a graph of the equalization

Fig. 8. Noise factor versus emitter current.



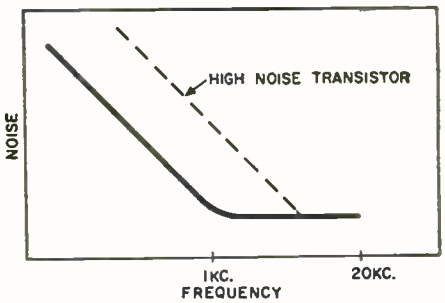


Fig. 9. Noise distribution for transistors.

required to compensate the signal appearing across R_4, as shown in the lower curve of Fig. 7. The required 15 db of bass boost below 250 cps is the function of R_7 and C_7. The 15 db treble boost is provided by R_6 and C_6. The equalization in the 12AX7 stage gives the output preamplifier response shown in the upper curve of Fig. 7. This curve was obtained using a pre-recorded stereophonic alignment tape, the *Sonotape* SWB-AL 101. A perfectly equalized system should give a flat output on playback. This provides correct equalization for nearly all of the recorded tapes on the market. It was found desirable to start the low-frequency roll-off at 50 cycles (see Fig. 1) in order to improve the signal-to-noise ratio. The high-frequency end starts to drop off because of tape head losses, as shown in Fig. 1.

(EDITOR'S NOTE: *All curves shown were obtained using a* Michigan Magnetics *stereo tape head, Model 5B20, although any high-impedance head rated at 5000-6000 ohms at 1000 cps would be suitable. Naturally, for stereo operation two preamps are required.)*

The standard reference level for signal-to-noise measurements in tape recorders is the maximum level at which a 400-cycle signal can be recorded at 2% harmonic distortion. The hybrid preamplifier of Fig. 6 gives a signal-to-noise figure of approximately 60 db, depending on the tape deck and head with which it is used. The noise level varies widely depending on the head structure and the shielding and physical layout of the motor and transformer fields, etc.

The harmonic distortion of the circuit measures approximately ¾% at 1 volt r.m.s. output. This is well below the tape's 2% harmonic distortion at the standard reference level for approximately 1.3 volt r.m.s. preamplifier output.

Noise Considerations

The 2N508 transistor was selected for use in this circuit because, basically, it is a high-gain, low-noise unit. A low-noise transistor circuit requires that the transistor be driven from a low-impedance source. The emitter impedance to ground should be low. The signal-to-noise ratio improves as the emitter current is decreased to a point where the gain reduction becomes greater than the noise reduction. This point varies with transistor

types but may be about .2 ma., as shown in Fig. 8.

Quite often a low-noise transistor is specified by a spot-noise figure measurement at 1000 cps with a very narrow bandwidth. Two transistors may be separated by 7 db with this measurement and by only about 2 db when the noise is measured over the entire audio spectrum. This indicates that the noise contribution differs at various frequencies and means that we cannot always judge the low-noise merits of a transistor by the 1000 cps spot-noise figure. Fig. 9 shows a likely pattern of noise distribution in the audio spectrum for a low-noise and a high-noise (dashed curve) transistor. The rising portion of the curve is often referred to as $1/f$ (flicker or excess) noise.

Usually the noise contributed by the 2N508 in this hybrid circuit is well below the noise level resulting from the hum and noise induced in the magnetic tape head.

The hybrid preamplifier circuit is easy to equalize since the compensation is divided between the bass and treble boost with each requiring less than one-half the conventional bass boost needed with tubes. Using a transistor eliminates many of the problems associated with the shock mounting of a tube to avoid microphonics. A better signal-to-noise ratio can be realized without resorting to selection of special tubes. Tape heads with different impedances may be used by changing the 12AX7 boost circuit for a flat output, using a standard test tape such as the *Sonotape* SWB-AL 101. —30—

PRE-FORMING PART LEADS

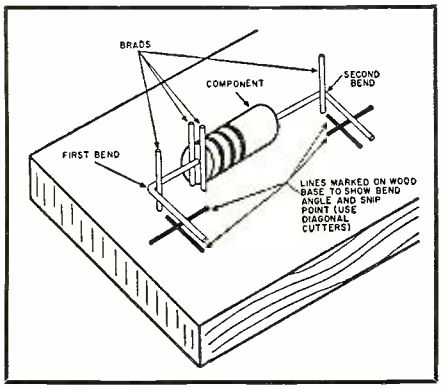
By ROBERT L. STONE

OBTAINING a professional-looking job when building up printed circuit boards is quick and easy with this method of pre-bending resistors and capacitor leads.

Dime-store brads and a block of scrap wood are all the materials required. Working with a prototype of the component to be duplicated, place it on the board and drive brads as indicated in the diagram.

Snip off brad heads with diagonal cutters. Remove the prototype and insert components to be duplicated. Bend the leads around the brads to the desired angle and snip to length. —30—

Board for pre-forming component leads.



losses, the distinct advantages of this propagation technique have made it worthy of exploitation. System reliability is a prime factor, as will be seen, and other advantages will become evident as the discussion continues.

V.H.F. and U.H.F. Scatter

It is now opportune to distinguish between the two types of scatter communication that have been developed, namely v.h.f. and u.h.f. Above the m.u.f., scatter from the ionosphere is utilized in the v.h.f. range of 30 to 100 mc. In particular, scatter from the *E* layer is used in the 50 mc. band. This has resulted in reliable links of from 500 to 2000 miles per hop. Experimental links in the v.h.f. bands have been established in northern regions, as well as in the United States, to investigate the effects of ionospheric disturbances on ionospheric scatter. Large rhombic antennas were aimed at the *E* layer at path midpoint and recordings of carrier strength divulged signal levels, signal-to-noise ratios, and fade effects. The experimental data confirmed the continuous variation of the signal, with fade rates up to 10 cps. Supposedly, this is due to multi-path effects as previously described. The fade may also be quite deep, often more than 20 db from average.

Ordinarily, radio communication in arctic regions is difficult because of polar blackouts, aurora, and other atmospheric disturbances. However, under circumstances such that regular communication links are ineffective, scatter has proved to be reliable and, in some cases, the signal has been enhanced by the disturbance. Scatter is unaffected by many ionospheric disturbances, so a high degree of path reliability is one of the very important values of scatter communication. Such v.h.f. scatter links, above the m.u.f., may be of fixed frequency and yet provide a consistent signal over periods of years. Scatter from the *F* layer has not been satisfactory for exploitation, but future work may disprove this. The *E*-layer scatter does not disappear at night as does ordinary ionospheric skip from this layer.

The channel space available in the u.h.f. bands is attractive, since in this region wide-band communication may be realized. Thus, the second type of scatter propagation has been developed in the range from 100 to 10,000 mc., using the "weather" atmospheric layer for "tropospheric scatter." There is no effective ionization in the troposphere, but there is variation in the dielectric constant and temperature of the medium as the air pressure changes with altitude. Water vapor may vary the dielectric constant, so the same "blob" theory of turbulence

applies to this medium of scatter. The tropospheric signal decreases rapidly with distance. The fall off of signal strength with frequency above the m.u.f. is rapid for ionospheric scatter, but is slow for tropospheric scatter. Tropospheric systems are therefore useful for path distances of from 100 to 500 miles.

Fading Problems

We have already mentioned that a scatter signal is characterized by a "normal" rapidly fluctuating fade due to the multiple signal paths in the scatter volume. Additional fades have been attributed to Doppler frequency shifts resulting from meteor trails, passing aircraft, or other moving objects in the path. Such fades may vary from microseconds to several minutes' duration and produce frequency and amplitude variations in the signal. Slow fades are also experienced where the average signal may change over periods of hours or longer.

Noise in the signal is generally due to cosmic rays or other solar sources. Aurora is associated with another noise modulation, named "sputter" because of its distinctive sound, resulting in a 200-300 cycle fade.

Because of the random variations of the fades, statistical studies have been made of the signal path losses with some interesting results. Complete statistical analysis takes into account Rayleigh and Gaussian probability distributions for fade amplitude and duration. It is found that the chances of ever receiving a 100% signal on the one hand and no signal (0%) on the other, are practically impossible. With a given system and signal path and over a long period of time, a certain "statistical average" or median signal-to-noise ratio will be found. The probability of signals falling short of this value can be determined. It may be found that for 1% of the time, fades of 20 db are experienced; and for 0.1% of the time fades reach 30 db. Thus, during these periods of time, fades will reduce the signal-to-noise ratio. Fortunately, the heaviest fades are encountered for the smallest percentage of time so that the minimum signal-to-noise ratio is found for only minimum time. For example, a link may have a median signal-to-noise ratio of 25 db. For 1% of the time fades may reduce this ratio to 11 db, and for 0.1% of the time, deeper fades may reduce it to only 5 db. In practical terms, it is seen that in order for this system to be reliable 99% of the time it must be capable of operating with a 11 db signal-to-noise ratio. To increase system reliability to 99.9% requires operation from 5 db signal-to-noise ratio.

Diversity reception provides some solution to the rapid fade problem. The signal will seldom exhibit the same fade at two different locations at the same time. Additional antennas, spaced some 50 to 100 wavelengths apart, have their signals combined. High orders of diversity, that is combinations of several antennas, may reduce the effects of rapid fades by adding the signals to a sum close to median level. This space diversity (addition of antennas) may be combined with frequency diversity (use of the same modulation on several frequencies) to combat the fast fade problem. Ideally, diversity combiners increase the signal strength during fades, without increasing the noise, so that signal-to-noise ratios are thereby improved.

By means of diversity, the signal can be recovered despite the fast fade introduced over the scatter path. The result is a highly reliable propagation path which is immune to the usual atmospheric disturbances.

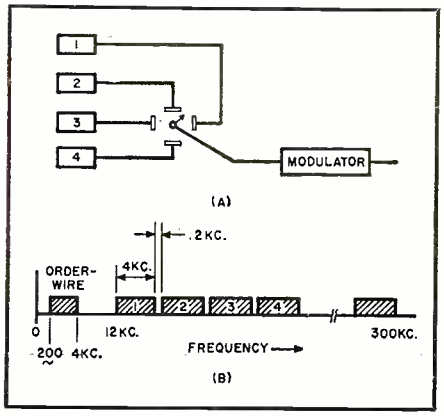
Equipment Requirements

Several requirements dictate the design of equipment for scatter. With a high path reliability to exploit, equipment should be extremely reliable, to insure dependable communication links. Because of the weak signal over the path, equipment must operate from minimum signal-to-noise ratios, with low noise factor and high sensitivity. For efficient spectrum utilization, multi-channel modulation is used to permit transmission of many telephone, teletypewriter, or facsimile signals simultaneously.

Multi-channel modulation is accomplished by "multiplexing" techniques. Frequency-division and time-division multiplex are the two methods most commonly used. Time-division multiplex may be likened to a commutator-type rotating switch which samples any particular signal circuit for only a fraction of the total time. Bits from each signal circuit share a common modulation channel, separated by time intervals. Only a part of the total signal information is utilized in the multiplex channel but, in many cases, the sampling rate is fast enough to collect adequate information.

Time-division multiplex requires minimum bandwidth and is used for modulating v.h.f. scatter systems, which have little spectrum space available. Many ingenious methods of

Fig. 2. (A) The time-division multiplex principle and (B) frequency-division multiplex method. For explanation, see text.



adapting this multiplex technique have been devised to fit the available bandwidth and to function with low signal-to-noise ratios.

With wide-band modulation available over u.h.f. scatter links, the wider frequency-division multiplex may be exploited. Fig. 2 illustrates the "baseband," which is the audio spectrum up to say 300 kc., divided into channels for individual signal circuits. Each channel is shown as 4 kc. wide, with 0.2 kc. guard space between the channels. Note that the space from 200 to 4000 cycles has been reserved for "order-wire," which is a telephone circuit used for technical adjustment and test of the scatter link. Usual multiplex gear will produce multiples of twelve channels, so a typical baseband may contain 12, 24, 48, or 72 channels. The individual signal circuits are injected into the baseband in the proper spot by a process of heterodyne frequency conversion. This may be compared to the action of a superhet receiver which converts the incoming signal into an i.f. signal by beating against a local oscillator. For baseband, the function is to "heterodyne up," since the final baseband frequency is usually higher than the incoming signal. This multiplex action permits many signals to share a baseband by frequency separation of channels. Frequency-division multiplex requires a wide modulation channel, but permits all intelligence in each channel to be simultaneously transmitted.

Thus, by multiplex methods, a scatter link can efficiently carry many narrow-band signals simultaneously or wide-band signals, such as television, may be transmitted over the wide-band modulation circuits of u.h.f. scatter systems.

Actual methods of modulation for scatter systems are currently being investigated. Both AM and FM have been utilized, with SSB showing definite advantages in many respects. System performance in the face of noise is of extreme importance. The threshold effect of FM seems to indicate the SSB will be superior at low signal-to-noise ratios. Theoretical investigations indicate that SSB is superior in reducing bandwidth, operating at low signal-to-noise ratios, and under multi-path fade conditions.

Designers are overcoming the problems of developing SSB scatter equipment for the u.h.f. bands. For example, sideband information must bear a definite relation to the carrier for most SSB receiving systems to operate, since a carrier must be re-inserted to recover the SSB modulation. Frequency shifts and fades over the scatter path may destroy this relation, if the carrier is completely suppressed. However, if greatly reduced pilot carriers are transmitted in the SSB system, these pilots may be used for recovery of the modulation without distortion.

With only one sideband transmitted, the SSB system requires considerably reduced bandwidth for a given amount of intelligence, as compared to FM. It also requires less transmitted power than other methods of modulation, which is an important factor in view of the very high transmitter powers used for scatter links.

Complete Systems

An idea of the complete scatter system may be gleaned from a description of the equipment. A typical v.h.f. scatter link might make use of high-gain antennas, separated for diversity reception. Antenna gains of over 20 db are possible with yagi, bedspring, corner reflector, or rhombic antennas measuring as much as 1000 feet per side. Special transmit-receive filters are included to permit the common antenna system to function for transmission and reception. The main and standby transmitters may well be 10 or 20 kw. installations in the 50 mc. band. Such transmitters may be similar to the high-power v.h.f. equipment used in TV broadcast service. High power output tubes, such as the 6166 may be used, with plate voltages above 5000 and plate currents of several amps. The exciter may be low power, utilizing balanced modulators and other SSB techniques. The tolerances will be found to be stringent, with distortion, intermodulation, and phase shifts kept within microscopic limits. In some systems, frequency stability of oscillators may be kept within one part in 100 million. Such exacting specifications are needed for certain types of SSB multiplex work.

Receivers are designed for minimum noise figure, high sensitivity, and minimum intermodulation distortion. Oscillators again are extremely stable. Accessory equipment is used to convert recovered multiplex into original teletypewriter or other signal intelligence.

Maximum equipment reliability is obtained by conservative design, complete spare transmitters and receivers, and rapid change-over facilities. This reduces the out-of-service time to a minimum.

For a u.h.f. scatter system, the antennas will usually be huge, specially designed parabolic dish reflectors fed by waveguide horns. Such antennas may be 28 or even 60 feet in diameter, with ingenious design to provide mechanical strength and minimum warpage with wind and icing conditions.

Diversity will again be found, with suitable microwave diplexing techniques utilized for transmit and receive. Power may be 10 kw. or more at frequencies of 1000 or 2000 mc., using huge multi-cavity power amplifier klystrons as output tubes. Bandwidth and linearity are design criteria and distortion is kept to very low levels. Exciters may use FM or SSB with multiplex or TV modulation.

Receivers use microwave crystal diode cavity mixers and traveling-wave tube preamplifiers. Cascode and low-noise i.f. amplifiers, often with double conversion, follow the microwave mixers.

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In general, it may be seen that permanent scatter installations are rather elaborate and complex. The antenna installations are engineering achievements in themselves. Including spare and standby equipment, a scatter installation may be the size of a high-power AM broadcast station. However, recent work has been directed toward producing portable scatter equipment, in particular for military tactical use. Systems of one kilowatt power or so have been mounted in truck-trailer vans, completely mobile with demountable antennas and primary power plants. Installations have been designed featuring inflatable antenna systems. Such equipment may be moved in cargo aircraft or by helicopter, ready for tactical use.

A comparison between a scatter link and a line-of-sight link is of interest. The over-all path loss of the scatter link may be 150 db or more while a typical line-of-sight path may have a path loss of 100 db. Although the link distance is greater for scatter, it is seen that some 50 db greater gain is needed for the scatter link. This is accomplished by higher power in the transmitter, probably 10 kw. as compared to 10 watts and an antenna gain of as much as 35 db as compared to 15 db.

Alignment of the scatter link is difficult because the two sites are beyond line-of-sight. The great circle path is used and surveying must be extremely accurate. Final alignment is for maximum signal strength. Path losses are often difficult to predict or calculate. The actual received signal may be −100 to −150 dbw. The received signal may fade into the noise level at times, but the diversity action previously discussed permits reliable operation at very low signal levels.

In comparison, it may be said that multi-path distortion and the limited spectrum space reduce the bandwidth possibilities of v.h.f. scatter systems, but hop distances of 500 to 2000 miles are possible. The u.h.f. scatter is limited to less than 500 miles per hop, but delay distortion is not as severe and spectrum space is available for wide-band modulation. Thus tropospheric scatter will provide facilities for multi-channel multiplex and TV circuits. The multi-channel possibilities make u.h.f. economical for expanding telephone and television networks.

Applications

The military and commercial applications of scatter equipment have spurred development and installation. Extensive scatter links are planned and being installed. Many military installations are classified, but it is common knowledge that the "Texas Tower" radar stations make use of scatter communication links, as do the DEW and other arctic early warning radar lines. Other military networks are being installed in North Africa and Europe.

Commercially, telephone and television interests see obvious advantages in scatter for extending and expanding present communications systems. Because of the increased separation possible between the stations, new links are practical. Over-water island hops are now possible and several are already in operation (between Florida and Cuba and between Puerto Rico and Dominican Republic). Several others are being planned. The future may find more countries and even continents interconnected with TV and communication scatter networks.

Additional propagation tests are planned, particularly during this International Geophysical Year, including tropical path studies. Transatlantic scatter systems are planned, in particular connecting Canada, Greenland, and the United Kingdom. This proposed scatter link at 30-45 mc. for voice and teletypewriter will do much to overcome the existing frequent blackouts in radio teletypewriter circuits. Transatlantic television links may be the next step. Truly, the future of scatter communication is "beyond the horizon." —30—

IMPROVING THE HEATHKIT MODEL CC-1 CRT CHECKER

By R. C. ELDRIDGE

ALTHOUGH this picture-tube tester indicates the presence of short circuits or leakage between various elements of the picture tube, it is not immediately apparent which elements are involved in such a fault. Such information can be of vital interest to the technician and to his customer, since this knowledge will have a great deal to do with deciding whether the picture tube may be salvaged and restored to operation, or whether the cost of a new tube will be required.

If the "Short" switch positions, originally marked 1, 2, 3, and 4, are relabeled respectively to read "pin 10," "pin 6," "pin 2," and "pin 11," the meaning of the neon-lamp indications becomes more directly usable. (See photo.) Alternatively some technicians may find it still more useful to label these positions — still using the same sequence — "first anode," "focus electrode," "grid No. 1," and "cathode." A glow at one switch position indicates that the electrode involved is leaking or shorting to the heater. A glow at two positions indicates leakage between the two electrodes involved. —30—

The "Short" indicator after modification.

New Tube Tester Data

Owners of Superior tube checkers: Keep up-to-date with the listing of the most recent tube types.

SUPERIOR MODEL TV-11

TUBE	FIL. VOLTS	F	N	P	LOAD	FIL. CONT.
KT66	6.3	2		5	3	2, 7
KT88	6.3	2		5	3	2, 7
1AB6	1.4	1		4	6	1, 7
1AC6	1.4	1		4	6	1, 7
1AE4	1.4	7	4, 5	6	6	1, 7
1AG4	1.4	3		4	6	3, 5
1AG5	1.4	4		5	6	4, 6
	1.4	4		3	6	4, 6
1AH5	1.4	7	2	3	10	1, 7
	1.4	7	2	6	6	1, 7
1AJ4	1.4	7	4, 5	6	6	1, 7
1C3	1.4	1	2	4	6	1, 7
1DN5	1.4	1		6	6	1, 7
	1.4	1		4	10	1, 7
1E3	1.4	4	3	1	6	4, 5
1G3	1.4	2	1, 3, 5, 8	T. C.	6	2, 7
1J3	1.4	2		T. C.	6	2, 7
1K3	1.4	2	1, 3, 5, 8	T. C.	10	2, 7
1M3	1.4	4	2	1	10	4, 5
1S2	1.4	1	4, 5, 6, 8, 9	T. C.	10	1, 2
2A4G	2.5	2		3	6	2, 7
2B25	1.4	1		4	10	1, 7
2E30	6.3	3	7	1	3	3, 4
3B4	2.5	4	2, 6	3	3	4, 5
3BA6	3.0	3		1	3	3, 4
3C4	1.4	1	5	6	3	1, 7
3CY5	3.0	3	7	1	3	3, 4
4AU6	5.0	3		1	3	3, 4
4BZ6	5.0	3		1	3	3, 4
4CS6	5.0	3		1	3	3, 4
5BS8	5.0	4		2	3	4, 5
	5.0	4		7	3	4, 5
5CB8	5.0	4		2	3	4, 5
	5.0	4		7	3	4, 5
5CM6	5.0	4	6	3	3	4, 5
5CQ8	5.0	4		2	3	4, 5
	5.0	4		8	3	4, 5
5CZ5	5.0	4	3, 8	6	3	4, 5
5EA8	5.0	4		2	3	4, 5
	5.0	4		9	3	4, 5
6AD4	6.3	2		1	3	2, 7
6AJ8	6.3	4		2	3	4, 5
	6.3	4		9	3	4, 5
6AQ4	6.3	3	5, 6	1	3	3, 4
6AQ8	6.3	4		2	3	4, 5
	6.3	4		7	3	4, 5
6BK4	6.3	2	3, 4, 6, 8	5	3	2, 7
6BM5	6.3	3		7	3	3, 4
6BM8	6.3	4		1	3	4, 5
	6.3	4		3	3	4, 5
6BN5	6.3	4		2	3	4, 5
6BQ5	6.3	4	1, 6, 8	2	3	4, 5
6BR5	6.3	4		1	3	4, 5
6BW4	6.3	4		1	3	4, 5
	6.3	4		7	3	4, 5
6BX4	6.3	3		1	10	3, 4
	6.3	3		6	10	3, 4
6BY7	6.3	4	1	2	3	4, 5
6CA4	6.3	4	2, 6, 8, 9	1	3	4, 5
	6.3	4	2, 6, 8, 9	7	3	4, 5

Test Bench PUZZLER: No. 2

By **BOB ELDRIDGE**

There was drive to the output stage and no defect in this circuit—so where did the high voltage go?

NO LITTLE consternation was caused by this case. Aside from being interesting of itself, it has something of a moral—for those who like their stories with morals. It shows that there really isn't anything you can take too much for granted, not even an apparently normal voltage at a key test point.

The set on the bench wasn't putting out a picture or raster of any kind, simply because it wasn't building up any high voltage. The first suspects when this symptom is present, of course, are any tubes associated with the horizontal or high-voltage systems. However, it is a routine procedure for all such tubes to be checked by direct substitution before the set ever reaches the bench. This had been done with no result.

When such a defect is noted and the tubes have been eliminated as suspects, it is the practice in the writer's shop to use the grid of the horizontal-output tube as a key test point. A reading is taken here with a v.t.v.m. (point 1, Fig. 1) to confirm the existence of a negative d.c. bias. Since this voltage is developed as a result of output from the preceding horizontal oscillator, existence of the proper bias will establish the fact that the oscillator is working, and further checks can be directed to the output stage and beyond.

The voltage found at the output-tube grid was −25 volts. This is a normal reading. The next check was made at the screen grid of this stage, point 2. Here a reading of 125 volts was found, which is somewhat on the low side. It was felt a better picture of the operation of this stage would be obtained if current through the tube were known. Accordingly, a voltage reading was taken at the cathode (point 3). Since this is the voltage drop across the 100-ohm cathode resistor which is in series with the tube, total current can be calculated readily from Ohm's Law.

Cathode voltage was only 5 volts. This was a rather strange figure, since it indicated that only 50 milliamperes of current were going through the tube. Average current through a 6BQ6GT is normally twice that amount. Furthermore, a fault in the output stage almost always results in *higher* current flow through the tube, rather than a reduction in current.

To round out the picture, the decision was made to check out the boosted "B+". The normal value expected in this receiver was 600 volts. The actual reading was 650 volts. Since this was high by less than 10 per-cent, many technicians would not regard the discrepancy as significant. Nevertheless, preparation was made to substitute the horizontal winding of a spare yoke for the existing one to see what effect, if any, this would have on readings. In the process of making this check, it was found that the boosted "B+" remained at 650 volts even when there was no yoke in the circuit at all! This was strange, since the reactance of the yoke is an important part of the load of the output stage at the frequencies normally dealt with here. With this first real clue, it was decided to switch from the v.t.v.m. to the scope to confirm a suspicion.

The suspicion was correct. What was the writer guessing at and why did he switch to the oscilloscope? Give it a try yourself before turning to page 123, where you'll find the answer.

—30—

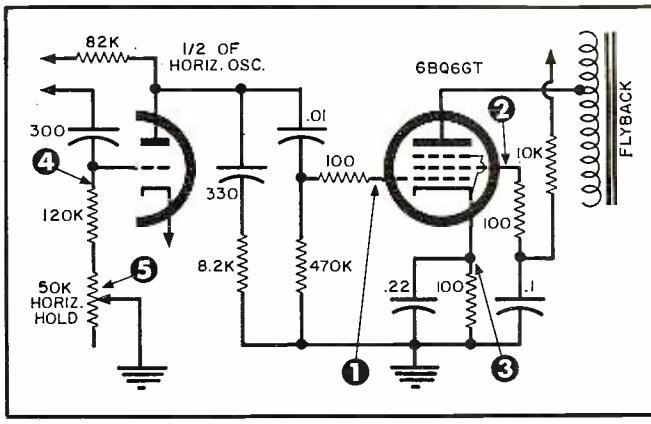


Fig. 1. Somewhere in this horizontal oscillator and output system, at a point that appears in the schematic, the fault that caused the absence of high voltage can be located. Do you know where it might be?

Feedback Amplifiers

(*Continued from page 45*)

of a negative feedback amplifier. In some of these more specialized circuits the modified tube plate resistance is of more importance than some of the other characteristics mentioned in this article. In other cases, this factor is of less importance.

The addition of negative feedback to electronic circuits results in increased operating stability. A v.t.v.m. using this circuitry holds its calibration despite deteriorating components, aging batteries, and reduced vacuum-tube emission. The amplification of a.c. voltages is practically independent of changes in plate supply voltages and hence changes in line voltages. In addition, the a.c. vacuum-tube voltmeter is able to measure signal voltages over a wider range of frequencies, making it more useful in audio work. Fig. 6 is a simplified circuit of an a.c. v.t.v.m. of British design. V_1 and V_4 are the input and output cathode followers while V_2 and V_3 are the *RC*-coupled signal amplifiers. The gain of this circuit is normally about 5000 but this is reduced to approximately 1000 through the use of a negative feedback circuit. This circuit is composed of R_1, R_2, R_3 and includes both V_2 and V_3 in the loop. It should be noted that the design only requires a gain of 1000 and hence there is nothing "lost" by employing a feedback circuit in this particular case.

The use of feedback in high-fidelity equipment is a more recent development than its corresponding growth in industrial electronics. But there is every indication that this growth will continue and become even more widespread. Distortion of a waveform must be removed at the source and a feedback amplifier does just that. A loss in voltage gain can be made up in other ways but once distortion is added to a signal it is, obviously, there to stay. —30—

"IT SURE GETS UP THERE-THATS 20,000 CYCLES"

Stereo Control Unit

(*Continued from page 43*)

tions, thence to both output jacks (J_2, J_6). Both channels are now in parallel, so that a monaural record being played with a stereo pickup is played through both amplifier-speaker systems. Isolation between the two preamps that are connected to the control unit is provided by R_5 and R_6. These resistors are shunted by capacitors to prevent undesirable loss of treble that would otherwise occur.

The second position of the selector switch is a "straight-through" stereo position, with input *A* going to output *A* and input *B* going to output *B*. This is the normal position that would ordinarily be used for stereo reproduction. In the third or "reversed stereo" position, a crossover connection is made. Now input *A* goes to output *B*, and input *B* goes to output *A*. This position is useful should the two stereo channels have become crossed in the hook-up. Now left and right channels are interchanged. The fourth and fifth positions are used when you want to play either one of the stereo channels or a monaural channel through both amplifier-speaker systems.

As may be seen from the circuit, the selector switch is a special unit that has been specifically designed to do its job simply and well. A more conventional rotary selector switch (for example, a 3-pole, 5-position unit) might also have been used, although the wiring would have been less direct. (See footnote)

A "Record-Playback" switch is provided to allow you to monitor the output of a tape recorder connected to the control center. With this switch in the "Playback" position, the output of the recorder is fed into the amplifier-speaker systems. In this position the normal input signals are disconnected from the control unit. Ordinarily the switch should be left in the "Record" position for usual operation. Note the use of the four 18-ohm resistors between all jacks and ground. These elevate the jacks above chassis ground and prevent the setting up of ground loops that might otherwise produce hum.

This stereo control unit is designed to be used with power amplifiers having input impedances of at least 100,000 ohms. Tape recorders to be employed with the unit should have an input impedance of at least 200,000 ohms. Interconnection cables used must be shielded and must be no longer than 3 feet each. The control center causes a slight loss in gain when inserted into an amplifier circuit, but in most cases this should cause no difficulty. Since the circuits are completely passive and no tubes are used, tube distortion and hum are non-existent. —30—

A somewhat different switching arrangement that has been used successfully was described by Ivan Flores in the article "Stereo Control Center" (January, 1958 issue).

Within the Industry

(*Continued from page 22*)

of research and engineering for *Midwestern Instruments, Inc.* . . . **MARSHALL A. WILLIAMS** is now director of marketing for *Farnsworth Electronics Company* . . . **LEE SCHWEITZER** has been appointed sales manager for *Colman Tool & Machine Company.* . . . **GERALD MILLER** is now the manager of dealer relations for the professional products division of *Ampex Corp.* . . . **WINFIELD WAGENER** is *Varian Associates'* new product manager, power tubes.

* * *

BURT C. PORTER has been unanimously elected president of "The Representatives." He is the head of the *Burt C. Porter Co.* of Seattle, Washington and has been a sales representative for over ten years. Mr. Porter has served as chapter delegate from the Cascade Chapter for the past year and has been active in chapter affairs for an even greater number of years. In his new position Mr. Porter promises a program of "positive action" for the year ahead and announces the establishment of a number of "task force" committees on both the national and local level to study the current problems of the association and to recommend appropriate action as quickly as possible.

* * *

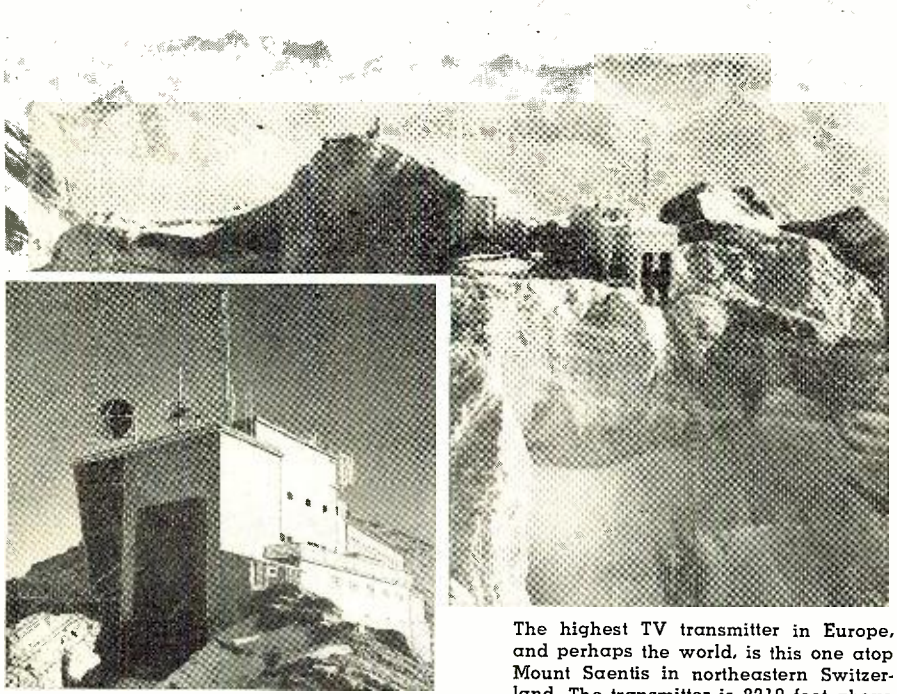
MAGNETIC RECORDING INDUSTRY ASSOCIATION has announced the unanimous election of the following officers for the 1958-1959 term: Irving Rossman, *Pentron Corp.*, president; Philip Gundy, *Ampex Audio, Inc.*, vice-president; Herman Kornbrodt, *Audio Devices*, secretary; and Charles Murphy, *Michigan Magnetics*, treasurer.

The following have been elected to serve on the board of directors: Wm. Deacy, *Reeves Soundcraft Corp.;* Arnold Hultgren, *American Molded Products;* Harry Sussman, *Telectro Industries;* Bernard Cousino, *Cousino Inc.;* Nat Welch, *ORRadio Industries;* and Merle Cain, *V-M Corporation.*

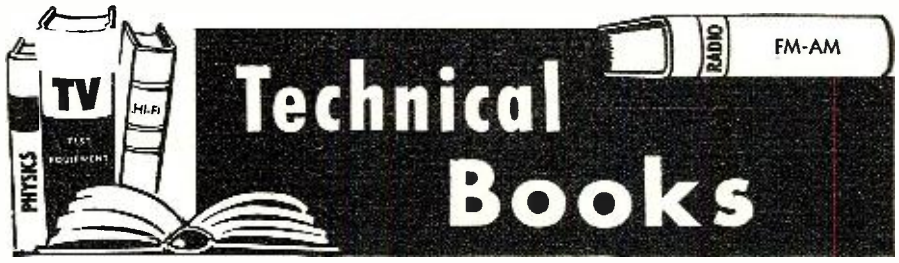
* * *

ELECTRONIC INDUSTRY SHOW CORPORATION has elected eight new directors to the board. The new directors were designated to represent their sponsoring trade associations on the Show Corporation's board of directors.

The directors are: Edward Rothenstein, *Arco Electronics Inc.* representing Producers of Associated Components for Electronics (PACE); Jack Hughes, *Littelfuse Inc.* representing Electronic Industries Association (EIA); Mrs. Helen Quam, *Quam-Nichols Co.* representing Association of Electronic Parts and Equipment Manufacturers (EP&EM); Wm. H. Thomas, *James B. Lansing Sound, Inc.* representing West Coast Electronic Manufacturers Association (WCEMA); and Carter W. Dunlap, *Dunlap Radio and TV Supply Co.,* George Wedemeyer, *Wedemeyer Electronics Supply Co.,* Roy J. Schneider, *Walder Radio and Appliance Co.,* and Sam Poncher, *Newark Electric Co.* all representing National Electronic Distributors Association (NEDA). —30—



The highest TV transmitter in Europe, and perhaps the world, is this one atop Mount Saentis in northeastern Switzerland. The transmitter is 8210 feet above sea level which is over five times higher than the Empire State Building where all New York City's TV station antennas are located. Fortunately, repairmen will not have to be Alpinists. An aerial cable car provides year-round access to the peak. The inset above shows a close-up view of the transmitter building and antennas perched high on mountain.



"ELECTRONIC HOBBYISTS' HANDBOOK" by Rufus P. Turner. Published by *Gernsback Library, Inc.*, New York. 154 pages. Price $2.50. Soft cover.

For all those hobbyists, Scoutmasters, high-school lab instructors, and teachers of similar ilk, here is one answer to the problem of finding interesting "projects" for students.

This volume contains over 100 circuits with parts lists for building a wide variety of tube and transistor devices. Such gadgets as amplifiers, oscillators, garage door openers, intercoms, timers, relay systems, and photoelectric devices are described in enough detail to enable duplication.

In addition to the purely constructional material, the author has covered laboratory safety and standard construction techniques. He explains how to solder correctly, the accepted methods of wiring, forming and cutting chassis, how to apply the "professional" touches, how to use tools properly, etc.

A copy of this book to a pre-teen boy and his buddies or the Beaver Patrol should keep the youngsters busy and out of mischief for the better part of a year!

* * *

"INDUSTRIAL CONTROL CIRCUITS" by Sidney Platt. Published by *John F. Rider Publisher, Inc.*, New York. 189 pages. Price $3.90. Soft cover.

Anyone with a basic knowledge of electronics can use this text to expand his vocational horizons to include the servicing of industrial electronic equipment.

The author covers electronic relay control and timing circuits, industrial photoelectronic controls, photoelectric control applications, electronic power controls, control circuits for gaseous and vapor-filled tubes, electronic d.c. motor controls, electronic control of welding, and industrial control instrumentation. In each instance the author uses actual equipment as the basis for his discussion.

Technicians operating in industrial areas where all types of electronic controls are in operation will find this volume helpful in providing the requisite knowledge for obtaining a slice of this lucrative business.

* * *

"MOST-OFTEN-NEEDED 1958 RADIO DIAGRAMS AND SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications*, Highland Park, Ill. 192 pages. Price $2.50. Soft cover.

Despite the fact that major emphasis has been placed on television—sets, servicing, and programming—radio is still flourishing mightily with more and more sets moving into the hands of the public each year. The alert technician never overlooks the revenue to be gotten from servicing radio receivers, auto sets, transistor portables, and combination consoles.

For this group, this new volume of radio diagrams will be of assistance. As with the previous volumes in the series, each set is covered by a complete schematic, alignment data, tube and trimmer location charts, and special servicing hints originated by the manufacturer.

* * *

"BASIC ELECTRICITY" by Abraham Marcus. Published by *Prentice-Hall, Inc.*, Englewood, N. J. 478 pages. Price $6.45.

Those familiar with the author's "Elements of Radio" will find in this new volume the same lucid approach to the subject matter as characterized the earlier volume.

Designed as a textbook for beginners, the treatment is basic with no prerequisite knowledge of physics or mathematics expected of the student. The book is divided into six main sections which deal with the nature of electricity, the d.c. phenomenon, alternating current, the various generators of electricity, the practical applications of electricity, with a final section on an introduction to electronics. In this concluding section the author covers electronic tubes and transistors and their applications in the fields of communication, industry, entertainment, radar, television, etc.

Test questions are provided at the end of each chapter and seven appendices provide the supplementary material needed by the student. —30—

NEW DEALER SET-UP

HEATH Company of Benton Harbor, Michigan which heretofore distributed its products exclusively by mail, has formed a new dealer organization to distribute and service its line of electronic kits in key market areas.

The new dealer organization will be supplied directly from the firm's new plant and will sell Heath products at a price slightly higher than those quoted in the company's catalogue and ads. Savings in delivery time and postage, plus the availability of fast, local service is expected to offset the higher dealer price. Mail orders will be continued.

Dealers have been franchised in Boston, Providence, Philadelphia, San Francisco, Los Angeles, Seattle, and Washington, D. C. areas with additions to be made later. —30—

CALENDAR of EVENTS

AUGUST 13-15
Electronic Standards & Measurements Conference. Sponsored by PGI, AIEE, IRE and NBS. Boulder Labs, National Bureau of Standards, Boulder, Colorado. Contact NBS for other details.

AUGUST 19-22
Western Electronic Show and Convention. Sponsored by L.A. and S.F. Sections of IRE and WCEMA. Ambassador Hotel and Pan Pacific Auditorium, Los Angeles. Further information is available from Business Manager, WESCON, 1435 La Cienega, Los Angeles.

SEPTEMBER 12-14
Seventh Annual Chicago High Fidelity Show. Palmer House, Chicago.

SOLUTION TO BENCH PUZZLER NO. 2

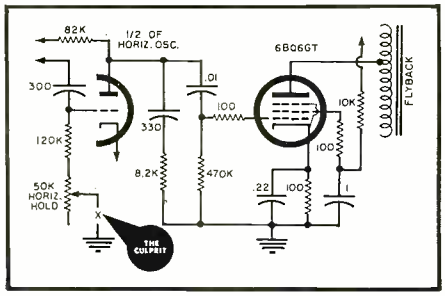
(*See page* 118)

SINCE the removal of the yoke from the output stage did not seem to affect loading of the stage (boost voltage appeared unaffected), the thought occurred that, although the horizontal oscillator was operating, it was probably running at too low a frequency for the inductance of the yoke to have much effect. For this reason the v.t.v.m., which can only be used to tell whether drive is being developed at the output-tube grid by the oscillator, was abandoned.

The scope was used because it can give an indication of waveshape and can also be used for an approximate indication of frequency. When it was connected to the grid of the 6BQ6, sure enough, it was found that oscillations occurred at about 2000 cps rather than 15,750!

Isolating the specific defect was now simply a matter of determining what constant in the oscillator had been changed. Although the 120,000-ohm resistor and the 50,000-ohm potentiometer in the grid of the oscillator (see diagram) were found to measure normally when checked individually, total resistance from grid to chassis ground was nearly 1 megohm. Closer inspection showed that the grounding lug at the bottom of the hold control was broken. Since two other circuits were grounded at this point, their incidental resistance was enough to keep the oscillator going—but at the wrong frequency. A victory for the scope over the v.t.v.m.!

Have you come across an interesting service job lately? Send it to the "Puzzler" Editor, RADIO & TV NEWS, *using this format. We will pay for items used at regular rates. Others will be returned.*



Loudspeaker Properties

(*Continued from page 42*)

by tuning and should be adjusted to coincide with the impedance peak produced by the speaker. The effect of high- and low-cabinet resonance is shown in Fig. 14B. These characteristics furnish a very convenient way to tune the reflex type cabinet, simply make the port larger than necessary then cover portions of it until an impedance plot possessing the desired double humps of equal amplitude is obtained. The amplitude of these humps can be reduced somewhat by lowering the "*Q*" of the cabinet to approach the "*Q*" of the speaker. Acoustic resistance is a property of the viscosity of the air and can be increased by stretching tightly woven fabric, such as silk or nylon, across the cabinet port. Be sure to stretch the fabric tightly so as not to add to the mass of the system, thus changing the resonant frequency.

As an interesting aside at this point, we may mention that almost any volume may be made into a Helmholtz resonator of practically any frequency. The limitation on size of a reflex type cabinet lies not in the volume necessary for resonance but in the size of the port necessary for sufficient low-frequency radiation. Any convenient volume may be used provided the tuning is carried out and the port size is sufficiently large. Port area is generally taken to be equal to or larger than the area of the speaker cone that is used.

The frequency of resonance of a Helmholtz resonator is given in reference 4 as:

$$f_c = 2070 \sqrt{\frac{\sqrt{A}}{V}} \quad . \quad . \quad . \quad (10)$$

where: f_c is the cabinet resonant frequency in cps

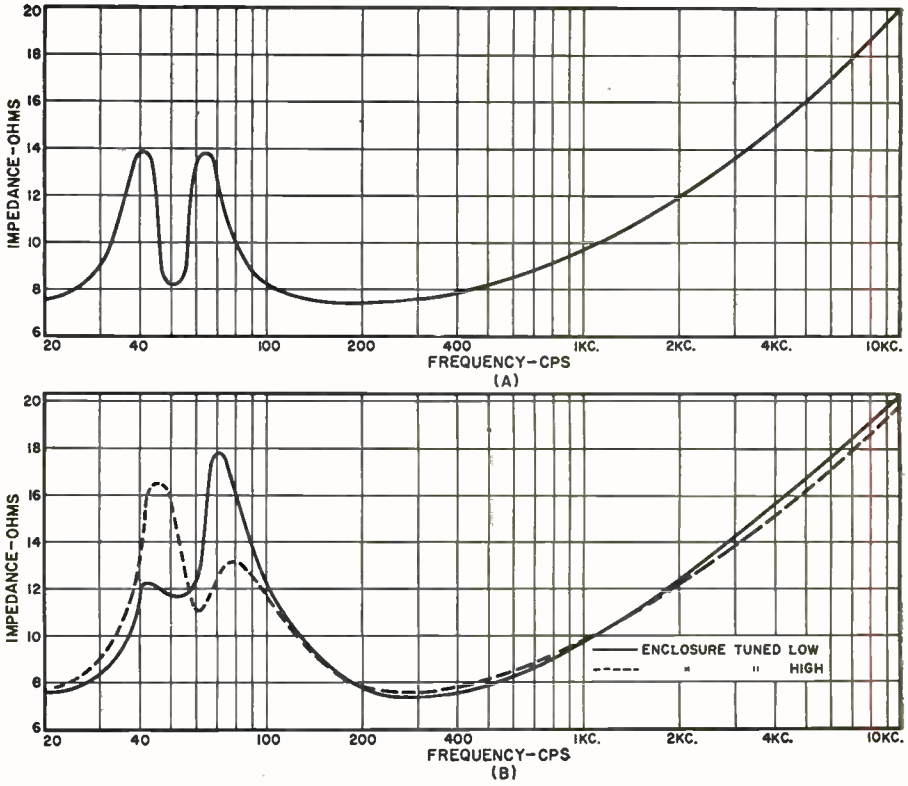
A is the port area in square inches

V is the cabinet volume in cubic inches. The equation may be solved for either A or V depending upon which is specified in a particular case. The value of f_c is, of course, determined by the speaker used. The area of the port should be made larger than the value obtained by calculation to permit tuning.

Speaker damping: One of the functions of a speaker enclosure is to load the speaker at its resonant frequency to remove the ringing effect. Whether or not this is being accomplished can be determined easily by what has come to be known as the "click-boom" method. This is merely listening closely to the speaker as a flashlight cell is alternately disconnected and connected to the voice coil. As the cell is connected a "click" will be heard as the cone is moved suddenly. When the cell is disconnected, the speaker is no longer damped by the cell and if the enclosure does not load the speaker properly, it will be free to vibrate at its resonant frequency and a mellow "boom" will be heard. The ideal would be where the sound were the same when the cell was disconnected as it was when the cell was connected to the voice coil.

Listening room acoustics: Most authorities agree that a reverberation time of ¾ second appears to be optimum for a listening room. This means

Fig. 14. A 15" unit in (A) properly tuned and (B) misadjusted reflex enclosure.



it should take ¾th of a second for the sound intensity to decay to one millionth of its original value. In the absence of a reverberation time meter, calculations can be made to get a reasonably good idea of the characteristics of the listening room. The reverberation time, T, is given by Sabine to be:

$$T = .05\left(\frac{V}{A}\right) \quad . \quad . \quad . \quad . \quad (11)$$

where: V is the volume of the room in cubic feet and A is the total absorption units in the room in equivalent square feet of open window. A brief listing of absorption units for various materials is given in Table 2. For a more complete table see references 1, 5, and 6.

Perhaps the best way to explain the use of this relationship, is with an example. Consider a room 15 feet wide, 20 feet long, and 8 feet high. The floor is covered with waxed cork slabs, the ceiling and walls are of varnished knotty pine. There are 125 square feet of drapes which completely cover the windows. The room contains a couch, three large chairs, and is usually occupied by two adults. To calculate the total absorption units, multiply the surface of each type material by its absorption coefficient and add the results for different materials. In the room just described, the absorption units total 98 sabines. The volume of this room is 15′ x 20′ x 8′ = 2400 cubic feet. From equation (11):

$$T = \frac{.05 \times 2400}{98} = 1.225 \text{ sec.} \quad . \quad (12)$$

If it is desired to decrease this reverberation time to ¾ second, equation 11 can be solved for A when T and V are known. In our example:

$$A = \frac{.05V}{T} = 160 \text{ sabines} \quad . \quad . \quad . \quad (13)$$

This means we must add sufficient absorption to provide 160 — 98 or 62 sabines. If we place carpets on the floor we will lose 15 sabines and gain 75 sabines for a net of + 60 sabines. This is sufficiently close to our desired 62 sabines, thus placing a carpet in our hypothetical room would solve the problem.

The links in the chain of audio reproduction which lie between the amplifier and the ear are truly complex. The tests and measurements described are not intended to oversimplify the problem. Conversely, they are intended to provide interested persons with an appreciation of the complexity of the loudspeaker, its baffle, and the room in which we listen.

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6. *Hodgman, Weast, Wallace & Selby: "Handbook of Chemistry and Physics," Chemical Rubber Publishing Co., Cleveland.*

—30—

THE annual volume of business involving the installation and servicing of electronic equipment has now topped two-billion, six-hundred-million dollars, according to a report submitted by EIA Service Committee Chairman Kenneth H. Brown at the Association's annual convention.

Brown, who is manager, Headquarters Service, TV-Radio Division of *Westinghouse,* said, "growth of the servicing industry by nearly three times in the last seven years has resulted in problems of expansion and stabilization.

"There remains," Brown reported, "a constant need for new radio and television servicemen and for upgrading and refresher training of practicing radio and TV servicemen, because the service industry is constantly losing technicians to other segments of the electronics industry."

The difficulty of keeping competent technicians in the service industry has been an unending topic for discussion at service-association meetings for a number of years. While the national volume of installation and service work has trebled, there has been a noticeable reduction in the average manpower per shop during this same period.

Service dealers attribute this steady loss of manpower to two major factors: (1) higher pay scales in other electronic activities and (2) the discouragement that comes from the constant pounding and criticisms that service technicians must take from customers.

Karl Heinzman, president of the Television Service Association of Michigan, recently pointed out that the wages paid service technicians in any given area are tied directly to the level of charges that prevail in that area. "When an area is tied to, say, a four-dollar service charge ceiling," he said, "dealers cannot pay their technicians competitive wages when the cost of giving that service is perhaps over five dollars per call.

"The only way that a dealer can sell service for less than it costs him," he continued, "is to make up the difference by padding service bills. The average employed technician is inherently too honest to stomach such practices."

Heinzman said that the sole purpose of the Detroit licensing measure is to create a healthy business atmosphere in which prosperous and successful service dealers will be able to pay competitive wages and build an industry which will be a credit to the growing field of electronics.

Interest in the Detroit licensing law on the part of service dealers in other areas has grown steadily and, as Heinzman pointed out in a recent report, "Detroit is becoming the focal point for information on this subject. Without a doubt, Detroit's television licensing ordinance and the beneficial results from it is a model that can well be adopted by any community. We are particularly interested in a continuing program of enforcement of the price resolution. We believe that no other single provision of Ordinance 110F has done so much to improve a situation that had deteriorated, as far as price or bait advertising was concerned, to a level wherein the consumer of television service was constantly victimized by such advertising. We take a firm stand in support of this resolution and intend to do all we can to implement its enforcement without exception."

Spurred by the success of the Michigan city's regulatory measure, state associations in Texas, Pennsylvania, and Indiana are taking a deep interest in supporting licensing measures of a similar type. The Indiana association, in particular, is launching a state-wide educational program to acquaint service dealers with the provisions of a service licensing bill which they hope to have introduced at some future session of the state legislature.

In many areas, local associations are proposing licensing measures to the city fathers of their communities. One of the most recent is an ordinance submitted to the city council of Norwalk, Connecticut, by a group of TV and radio service technicians in that area. The bill is intended to license and regulate companies and individuals dealing with TV, radio, and other electronic devices.

The Norwalk bill proposes a $25 annual fee for a "master's" license and $3 for each technician employed by the "master". It also provides that all work must be done at the home of the owner and that all invoices must be itemized and bear the license number of the license holder.

A "good moral character" is one of the prerequisites for obtaining a license. Other requirements of the measure include the ownership of certain basic test equipment, filing of proof of insurance, and qualification of employees by the "master" for whom they work.

On the other side of the licensing fence, The Electronic Association of Missouri contends that sincere self-regulation will accomplish more than could be done under local or state

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MADE IN ENGLAND

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Reg. $59.95 — 4 for $90.00

$23.88 Stock No. RP-46

Hand built and beautifully finished by old world craftsmen. Absolutely jam proof and fool proof. Ten record capacity—can be intermixed. Rubber padded turntable is rim driven and rides in a Ball Bearing Race. Turn-over Dual Sapphire Hi-Fi Cartridge is also 100% guaranteed for 1 year along with the changer, motor and all moving parts. 115 Volts. 60 cy AC. Shpg. Wt. 16 lbs.

SPINDLE FOR ABOVE, Stock No. RP-7 $2.37
BASE FOR ABOVE, Stock No. CA-48 . . $4.07

Magnavox 4-Pc. Hi-Fi Speaker

Reg. $25.25 — **$14.88** COMPLETE — Stock No. AS-371

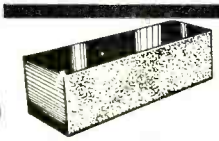
Quality Magnavox construction throughout. The 15" Woofer delivers powerful bass and amazing mid-range response. Heavy cadmium plated frame, dust cover and 1" dia. voice coil. Combine this with the "Deep Throat" Tweeter and you have the assurance of full range brilliance. Add the special non-polarized capacitor and a new thrill in Hi-Fi is yours at a price that defies comparison. Shpg. Wt. 13 lbs.

Magnavox 15" Hi-Fi Woofer
40-8,000 cps. 8 ohm—35 watts
Reg. $13.50 — 3 for $25.00 — **$8.95** ea.
Stock No. S-331

Magnavox 4" Tweeter
To 17,000 cps. 8 ohm
Reg. $5.25 — 3 for $8.50 — **$2.99** ea.
Stock No. S-332

Magnavox Crossover Capacitor
Stock No. C-871 — 3 for $2.50 — **88c** ea.
Reg. $1.25

"TWOOFER" SPEAKER — TWEETER & WOOFER IN ONE CONE



10½ x 3 x 3"
Stock No. S-328

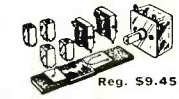
$4.88 Ea. — 3 for $13.50

Amazing "Twoofer" may be placed on desk, book shelf, counter top or hung vertically or horizontally. Covered with simulated suntan leather with contrasting grille cloth front and back. Speaker is ideal for small areas. (size 2½ x 10"). P. A. systems, intercoms, etc. Voice Coil 3-4 ohms. Rated at 5 watts. Shpg. Wt. 3 lbs.

• SPEAKER ONLY, Stock No. S-329 . . . . . Each $2.99

8-PC. BASIC COMPONENT KIT
For Superheterodyne Transistor RECEIVER

3 for $14.00 — **$4.95** — Stock No. AS-334



Reg. $9.45

Consists of 1—oscillator coil. 3—matched I. F. transformers. 1—dual gang miniature variable capacitor. 1—Hi-Q ferrite core loopstick antenna coil. 1—subminiature audio driver transformer and 1—subminiature push-pull output transformer. Schematic included. Shpg. wt. 2 lbs.

VERTICAL POLARIZED WHIP ANTENNA AN/130
With Gooseneck Base & Loading Coil

39c

3 for $1.00
20 for $5.00
100 for $22.50
Stock No. AA-44

Total length 32½". High quality brass tubing with removable top section. For use in 2S MC region. Perfect for transceivers, aircraft receivers, experimental units, etc. Flexible, bend into any direction desired. Mounts with single nut. Shpg. wt. 3 lbs.

STEWART-WARNER MOTORS
6 VOLT DC—Worth $4.00

$1.00 Ea.

3 for $2.00
10 for $6.50
100 for $60.00
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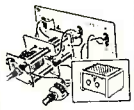
For production, experiment, fans, models, etc. Brand new. Buy at less than maker's cost. 2 pole field winding and 7 pole armature provides high speed operation. Self-centering shaft and spring pressure graphite brushes. Size 2¾" x 2⅜" diameter. Shaft length ½", ¼" diameter. Shpg. wt. 2 lbs.

"Phasitron" Variable Inductor

Reg. $7.95 — Stock No. AA-46

$1.19 Ea. — 3 for $3.00



"Phasitron" combines the signals from two antenna bays for maximum gain and signal to noise ratio. Works by adding or cancelling voltages from antenna bays. In walnut case 7⅜" x 5½" x 5⅜". Shpg. Wt. 4 lbs.

DRY CELL REJUVENATOR KIT

3 for $8.50 — **$2.88** Ea. — Stock No. KB-57

• Double and Triple Flashlight Cell Life

Bring back life to otherwise inactive cells in the flashlight or portable radio. Controlled amounts of current are applied to the cell to remove charge built up around positive pole and allows cells to function again. Complete, ready to assemble. For all three popular flashlight cell sizes. Shpg. wt. 1 lb.

7-Pc. ROTO HOLESAW SET

1"—1¼"—1½"—1¾"—2"—2¼"—2½"

$2.77 SET — Reg. $5.95 — Stock No. TL-111

The seven high carbon steel blades—plus adapter is for use with any ¼" electric drill. Cut wood, metal or plastic up to ¾" thick. Includes drill for making its own starting hole. Shpg. Wt. 2 lbs.

TRIPLETT 0-500 Microammeter

Reg. $10.60 — Stock No. ME-25

$2.99 Ea. — 3 for $8.50

D'Arsonval 0-500 microamp movement accurate to within 2% of full scale. Bakelite case. Size: flange 2¾" dia.; body 2⅜" dia.; overall depth, 1⅛". Shpg. Wt. 3 lbs.

Shield "Super Tweeter"

- For 8-16 ohm speaker
- With 35 watt unit
- 2,000 to 17,000 cps.

Reg. $27.50 — **$9.88** — 3 for $29.50

Stock No. S-326

Latest development in a versatile high frequency horn. Goes over the top in response with a silky smoothness, a wide angle distribution pattern and complete freedom from distortion. For use with any speaker. Overall size: 7¼" x 3" x 6½". Requires cabinet opening: 6" x 2". Shpg. wt. 4 lbs.

GENERAL ELECTRIC HI-FI EQUIPMENT CABINET A1-211

Reg. $99.95

MAHOGANY Stock No. CA-104 — **$49.95**

BLONDE Stock No. CA-105 — **$51.95**

Beautifully styled and finished on all FOUR sides for versatility of placement. Designed for custom mounting of preamplifier, amplifier, tuner and record changer components . . . plus a record storage compartment. An opening in the cabinet bottom, combined with four slots on the top panel, provide excellent ventilation. Shpg. wt. 50 lbs.

Overall-size: 26 3/16 H. x 30 3/16 L. x 17" W.
Equip. Comp.: 20¼ H. x 14⅞ L. x 12" W.
Record Comp.: 8 H. x 16 3/16 L. x 14¾" W.
Record Changer Comp.: 12 H. x 16 3/16 L. x 15⅜" W.

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MONEY BACK GUARANTEE: Everything you order from Olson is guaranteed as advertised. If you are not more than satisfied, you may return merchandise for cash refund.

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Olson Radio Warehouse

T-88 FORGE ST. AKRON 8, OHIO

regulation by license. In a recent editorial on the subject, W. C. Pecht, editor of the association's official organ, "Team News", said:

"An alternative to licensing is more sensible. And there are only a few things to be done which will accomplish the same 'good' with none of the 'bad' in a license law. First, the existing laws covering fraud should be amended in such a way that all industries and services are subject to prosecution, regardless of the amount of money involved. The fine or jail term should be in proportion to the extent of the fraud and in the case of petty fraud, enough to make prosecution possible. It should be amended further to apply in the same manner to false accusation of fraud. Second, with voluntary registration of the technician under an act similar to that used by public accountants, the public can choose between state certified technicians and others. Everything that the proponents of licensing want, with one exception, is to be had under the two suggestions. The exception is, the limiting of competition—fair, ethical, healthy competition."

Association Activities

The Television Service Association of Connecticut, Inc. elected William Stanek president at its annual convention.

Members named to serve with him include: Joseph Francis of Groton, vice-president; Deane Gould of Waterbury, secretary; Anthony Lacapo of Meriden, treasurer; and Peter Lucas of Willimantic, financial secretary.

Robert Steer of Stratford will continue to serve as business agent for the association.

At the annual meeting of the Indiana Electronic Service Associations, delegates from member associations named Charles Conwell of Kokomo, Indiana president for the coming year. James W. Baker of *Lapel TV Service,* Lapel, was elected vice-president; Ed Carroll of *Carroll's TV,* Indianapolis, was re-elected treasurer; and Robert M. Sickels of *Sickels' Radio & TV,* Indianapolis, former IESA president, was chosen to fill the office of secretary.

Concurrently with the annual election, member associations of IESA launched an aggressive program for the purpose of encouraging the formation of new associations in cities where none exist at the present time. Through the medium of the "Hoosier Test Probe," the official magazine of the Indianapolis Television Technicians Association, a state-wide campaign to arouse dealer interest in licensing is planned.

John V. Glass of St. Louis was re-elected president of the Electronic Association of Missouri. Those named to serve with him include: Richard L. Richter, vice-president; Arthur A. Mayer, secretary-treasurer; Robert Lucas, recording secretary; and Joseph McMillian, sergeant-at-arms. New directors elected by the St. Louis organization include Edward Haines, Joseph McMillian, and Stanley Siegel.

G-E Tube Inventory Plan

The enormous list of currently active tube types has created a genuine inventory headache for dealers and distributors. In an attempt to assist dealers and technicians, RADIO & TV NEWS publishes an annual inventory guide list, which covers the most important tubes in use, together with quantitive ratings indicating probable frequency of turnover. To assist distributors, *General Electric* has launched CARI (controlled automatic replenishment of inventory).

Each shipment of a given tube type to a distributor includes a prepunched, business-machine, data-processing card. The distributor returns these cards to *G-E* where they are automatically processed to determine the rate of flow of the particular type for his establishment. Based on the information obtained in this way, *G-E* ships tubes automatically to the distributor in accordance with his needs. —30—

A novel hi-fi sales promotion, developed by Koessler Sales Company of Los Angeles, is bringing representative equipment to their customers' doors via a mobile showroom housed in a Volkswagen "Transporter." Tape recorders, stereo systems, amplifiers, preamps, and record playing equipment can be demonstrated on the spot. Units made by James B. Lansing, McIntosh, Thorens, Electro-Sonic, Magnecord, Glaser-Steers, and American Microphone are regularly shown.

Answer to Puzzle appearing on page 109.

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RATE: 50¢ per word. Minimum 10 words. October issue closes August 11th. Send order and remittance to: RADIO & TV NEWS, 1 Park Ave., N. Y. C. 16, N. Y.

RADIO ENGINEERING

ELECTRONICS! Associate degree—29 months. Technicians, field engineers, specialists in communications, missiles, computers, radar, automation. Start September, February. Valparaiso Technical Institute, Dept. N, Valparaiso, Indiana.

ENGINEERING Degrees, EE Option Electronics earned by home study. Residence classes also available. Pacific International University (operating as a college of engineering only at present), 5719-C Santa Monica Boulevard, Hollywood 38, California.

FOR SALE

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN. Hartford 1, Conn.

RADIO & TV Tubes at manufacturers prices. Guaranteed—Send for free price list. Edison Electronic Tube Co., Menlo Park, N. J.

GOVERNMENT Sells—Surplus Electronics; Walkie-Talkies; Transceivers; Test Equipment; Oscilloscopes; Radar; Voltmeters; Misc.—Fraction of Army costs—Buy direct now from U. S. Government—"Depot List & Procedure" $1.00—Brody, Box 8-RT, Sunnyside 4, New York.

TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality, Top Name Brands Only. Write For Free Catalog or Call WAlker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

TELEVISION Sets $11.95. Plus shipping. Jones TV, 147 High, Pottstown, Pa.

DIAGRAMS! Repair Information! Radios—amplifiers—recorders $1.00. Televisions $1.50. Give make, model, chassis. TV Miltie, Box 101RA, Hicksville, New York.

1" MINIATURE Meters: All stock ranges available, free literature: Alco Electronics, Lawrence, Mass.

OSCILLOSCOPES — Tektronix — Excellent Condition. Two Model 315D—$280.00 ea., One Model 511AD—$200.00. Electro-Pulse, Inc., 11861 Teale St., Culver City, California.

INSULATORS, 250, New, Government Surplus; Shipped Free; $4.95. Fitzpatrick Sales, 60 Curtiss Circle, Miami Springs, Florida.

SELL: Hewlett Packard VTVM 410-D $135.00; Oscillator 200 CD $90.00. Excellent Condition. A. C. Smrha, 12 Mountainview Drive, Westfield, N. J

BEST Offer over $125 buys my $250 Zenith All-Transistor Trans-Oceanic Portable. Never used. Nathan, Suite 2018, 37 Wall Street, New York 5.

TELEVISION & RADIO Tubes, Parts and Supplies. Guaranteed. Hi-Quality Tube Co., Inc., 284 Lafayette St., Rahway, New Jersey.

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QUICKLY Locate Intermittent Flybacks and B-boost filters. Write Telson Electronics, Rapid City, S. Dak.

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CYLINDER and old disc phonographs. Edison. Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Classified Box 50 % Radio & TV News, 1 Park Ave., N. Y. C. 16, N. Y.

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WANTED: Receiver R5/ARN-7, MN-62A Transceivers, RT18/ARC-1, AN/ARC-3, BC-788C, 1-152C, Collins, Bendix equipment, Test Sets, Dynamotors, Inverters. We pay highest prices. Advise quantity, condition, price first letter. Aircraft Radio Industries, Inc., 70 East 45th St., N. Y. 17, telephone LExington 2-6254.

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PRICE? Try ours! Everything in HI-FI. Factory-sealed components. Send for free catalog. Audion, 64-62T Booth St., Rego Park 74, N. Y.

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HI-FI Haven—New Jersey's leading sound center. Write for information on unique mail order plan that offers professional advice and low prices. 28 Easton Avenue, New Brunswick, N. J.

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RECORDERS, HiFi, Tapes, Free Wholesale Catalog. Carston 215-R East 88 St., N. Y. C. 28.

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DISCOUNTS to 50%, recorders, tapes, hi-fi components, consoles, photograph equipment. Request specific prices only. Long Island Audio & Camera Exchange, 3 Bay 26th Street, Brooklyn 14-N, N.Y.

AMPEX, Concertone, Crown, Ferrograph, Presto, Tandberg, Pentron, Bell, Sherwood, Rek-O-Kut, Dynakit. Others. Trades. Boynton Studio, 10RT Pennsylvania, Yonkers, N. Y.

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TV Servicemen; Here's the answer to your prayers! Sure fire, practical trouble shooter for all makes. Not a book, not a kit, but a classified, step-by-step trouble tracker. Save money, time; eliminate "call-backs." Free brochure. Write National Technical Research Labs, 432 N. Washington Ave., Whittier, Calif., Dept. R.

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MISCELLANEOUS

DECALS—Trademarks, Service, Sales, etc. Write Allied Decals, Inc., 8378 Hough, Cleveland, Ohio.

"HOME Brewed Wines, Beers." Complete Book $1.00. ABC Publications, Box 849, San Francisco 1-EP, Calif.

INDEX OF Advertisers

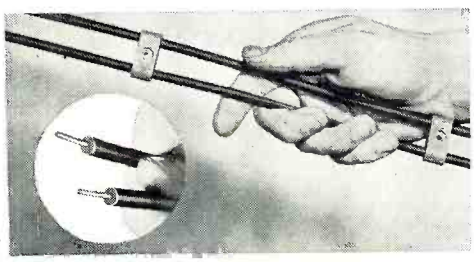
AUGUST 1958

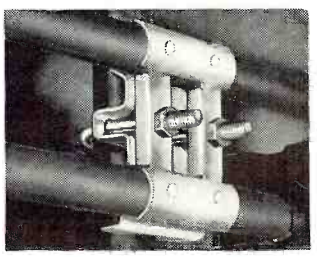
While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

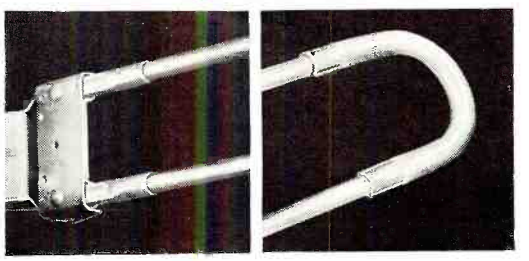
Exciting News From CHANNEL MASTER'S Test Lab!

New 350A Series "T-W" Antenna — 7, 5, and 3-element models.

5 *New Performance And Durability Features Are Built Into The NEW T-W Antenna*







1. New Weatherproof Harness Delivers Peak Performance In All Climates

Give your customers the world's most powerful TV antenna performance . . . and never worry about weather problems. The extra-thick ¼" virgin polyethylene insulation protects impedance match and electrical efficiency against rain, salt, or sea air. 16 gauge copper conductors. Dealers in coastal areas will particularly go for this new T-W feature.

2. New Mast Bracket Installs Faster

A few seconds is all it takes with the new single ⅜" U-bolt. New design mast bracket is really rugged, too. 4 rivets through the bracket and mast secure the antenna permanently in place . . . can't ever twist or slip out of position.

New Ruggedized Elements Provide Extra Durability

3. Seamless ½" diameter external sleeves supply "shock-proof" reinforcement of all elements at the brackets.

4. All dipoles are reinforced at the fold with a seamless ½" diameter U-bend.

5. 20% heavier wall thickness on all elements.

PLUS FAMOUS "*TRAVELING WAVE*" PERFORMANCE!

Highest Gains . . . Highest Front-To-Back Ratios of Any VHF Antenna.

CHANNEL MASTER CORP.

ELLENVILLE, N. Y.

The World's Largest Manufacturer of Television Antennas

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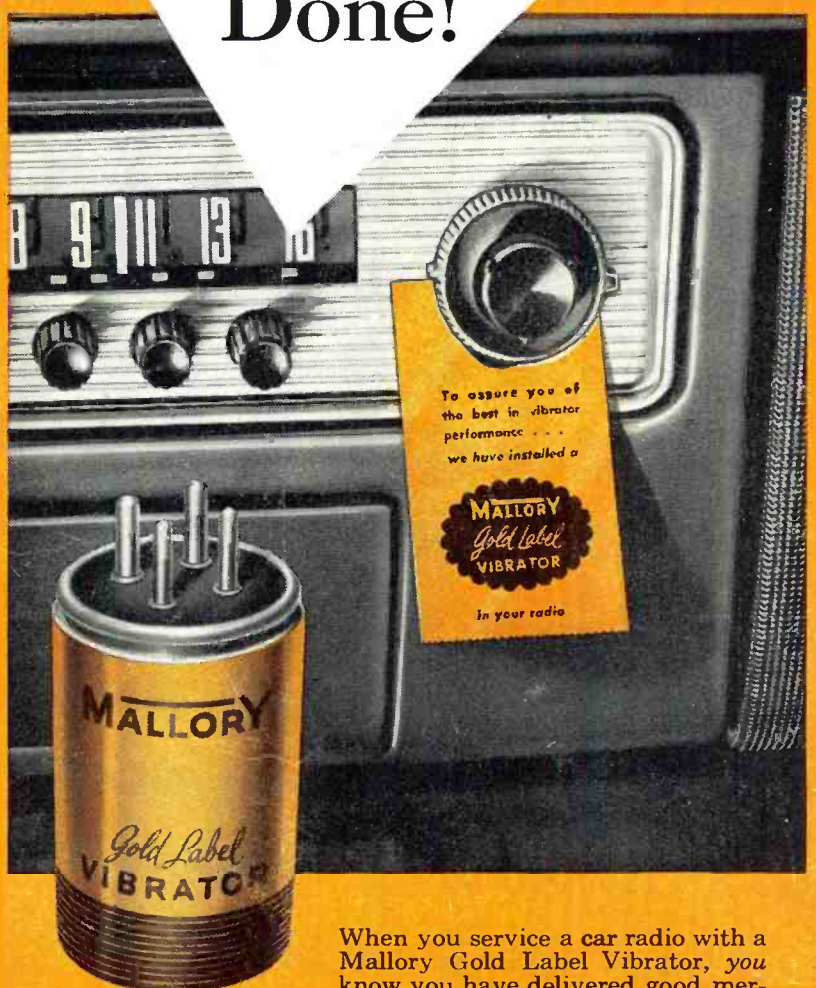
Sign of a Job Well Done!



When you service a car radio with a Mallory Gold Label Vibrator, *you* know you have delivered good merchandise and exercised good judgement. You can remind the customer that his car radio has received this *preferred* treatment by hanging this attractive gold tag — supplied with each Gold Label Vibrator—on a knob of the radio. It's a reminder to your customer that his set has been serviced with the finest.

This helpful promotion is another good reason to be sure to always ask for Mallory Gold Label Vibrators . . . the standard of performance. Get them from your Mallory Distributor.

P.R. MALLORY & CO. Inc.
MALLORY

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