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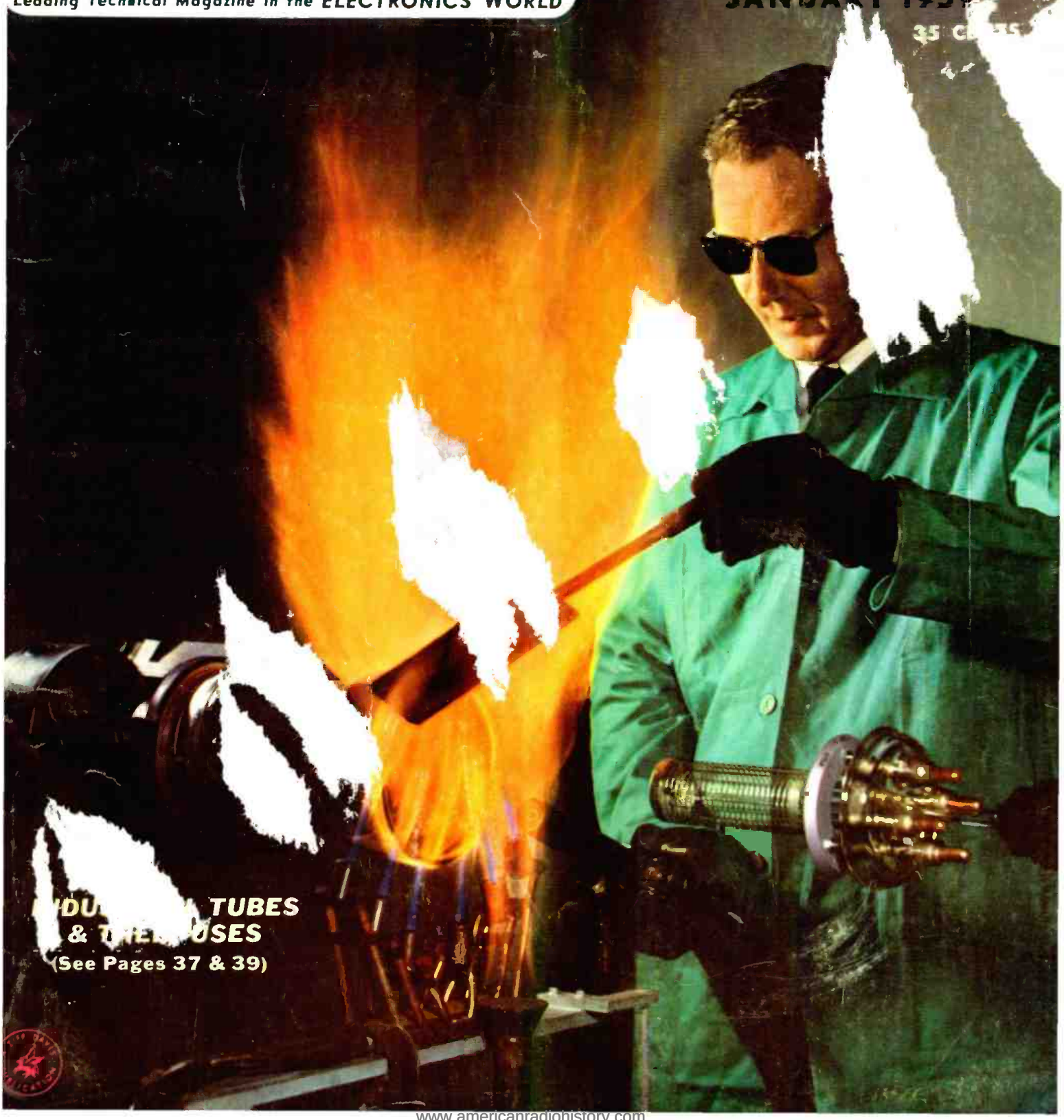

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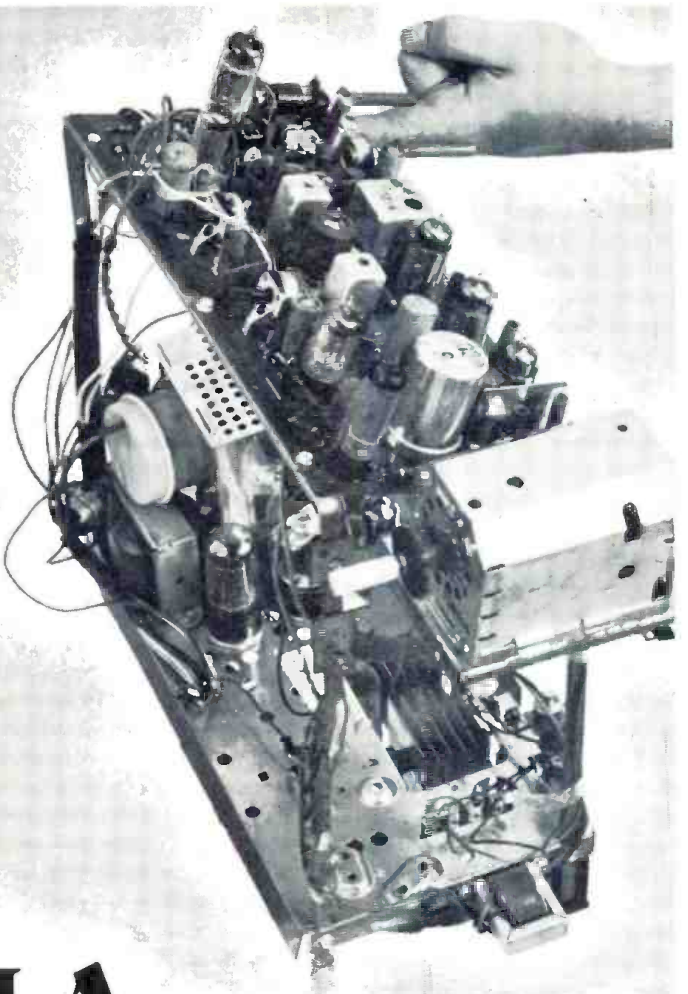

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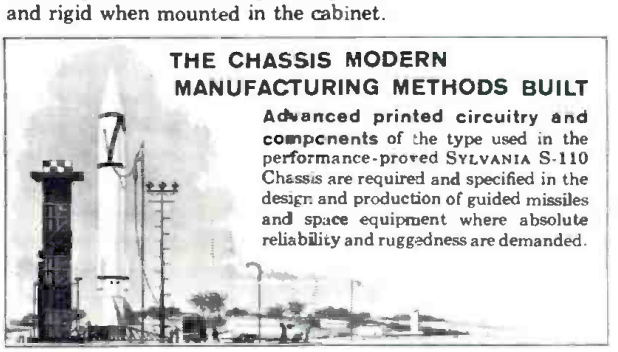

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Editorial and Executive Offices
One Park Avenue
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BRANCH OFFICES: Midwestern Office, 434 S. Wabash Ave., Chicago 5, Ill.; Western Office, Room 412, 215 W. 7th St., Los Angeles 14, Calif., John E. Payne, manager.

FOREIGN ADVERTISING REPRESENTATIVES: D. A. Goodall Ltd., London; Albert Milhado & Co., Antwerp and Dusseldorf.

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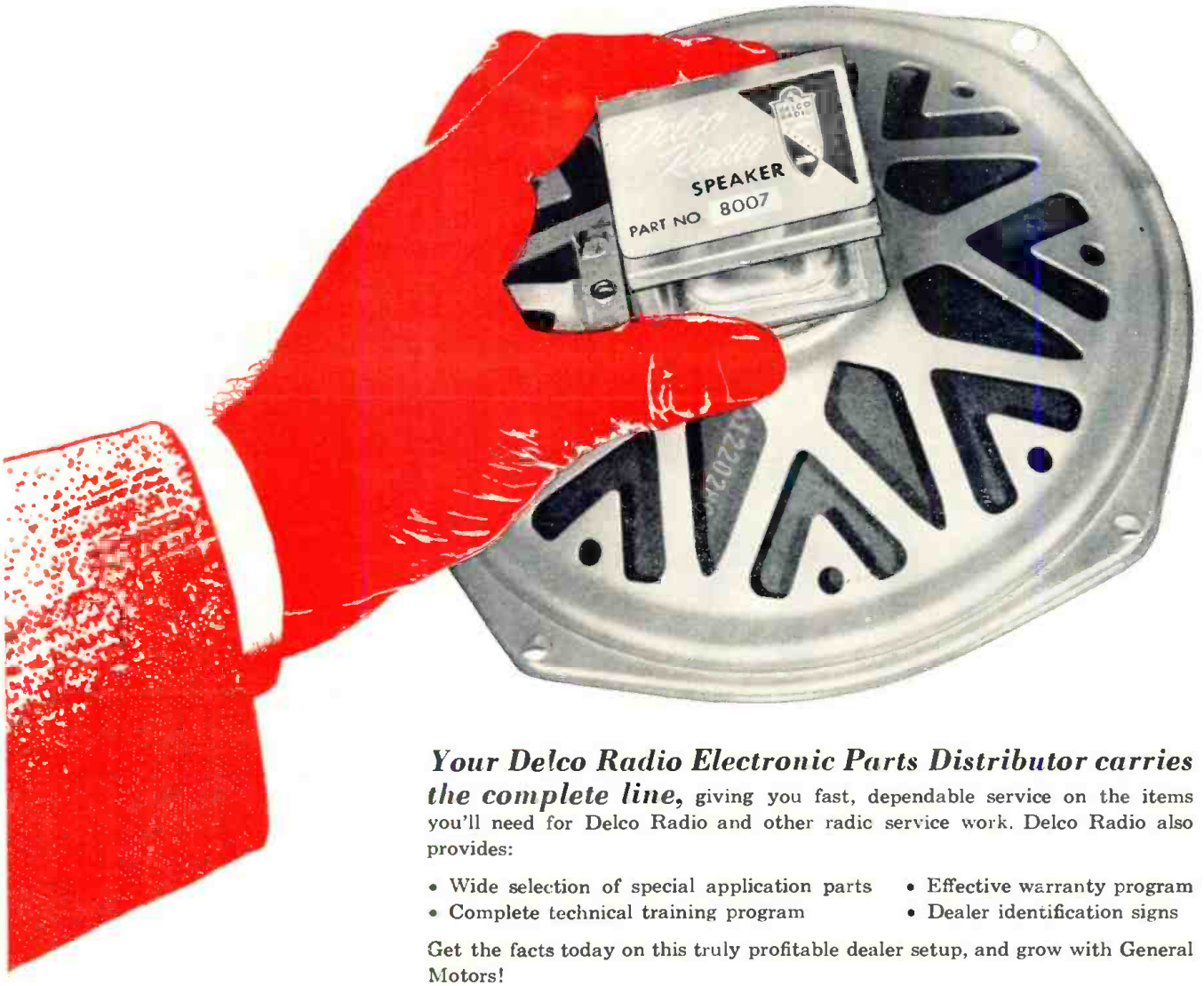

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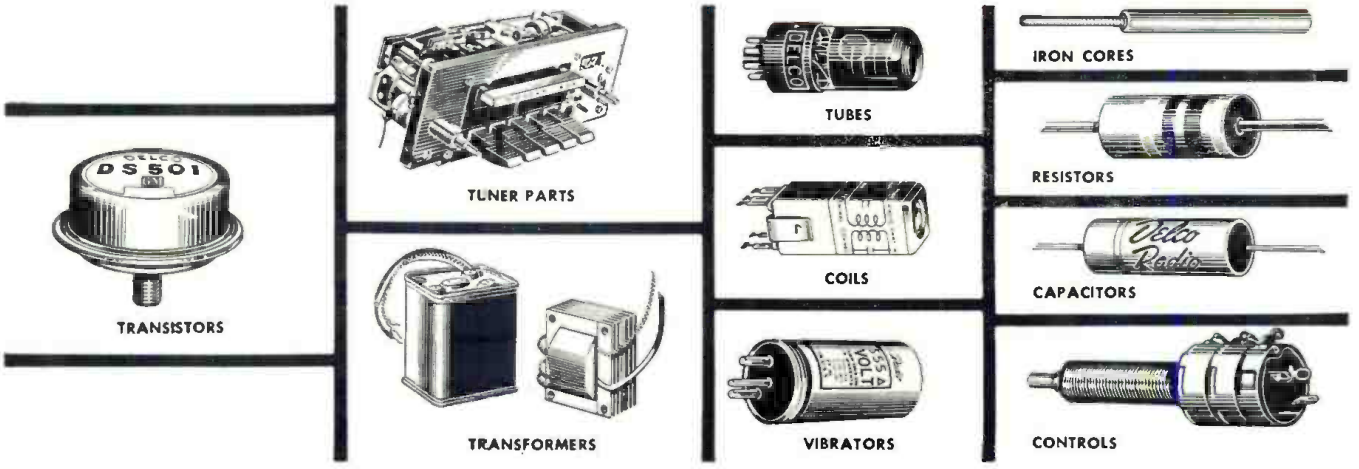

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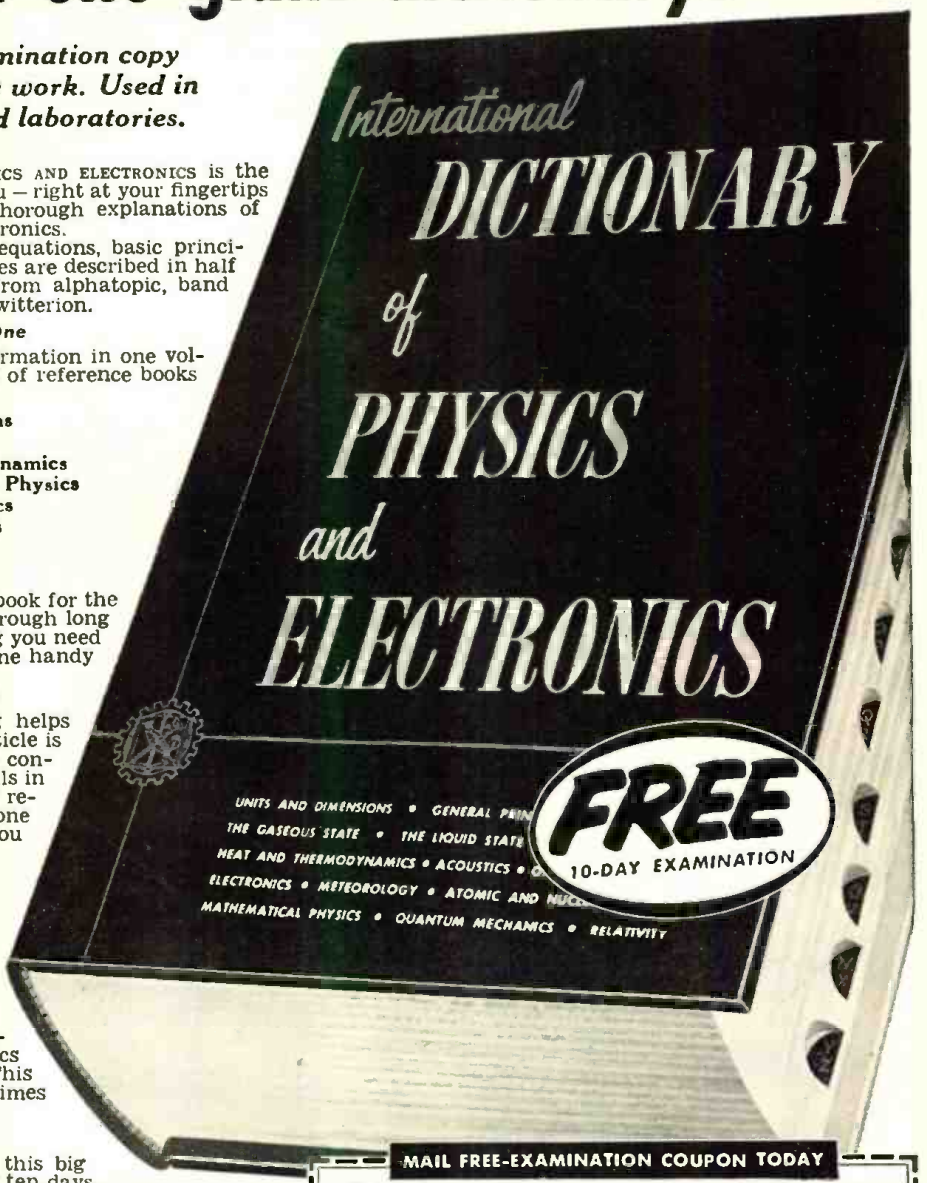

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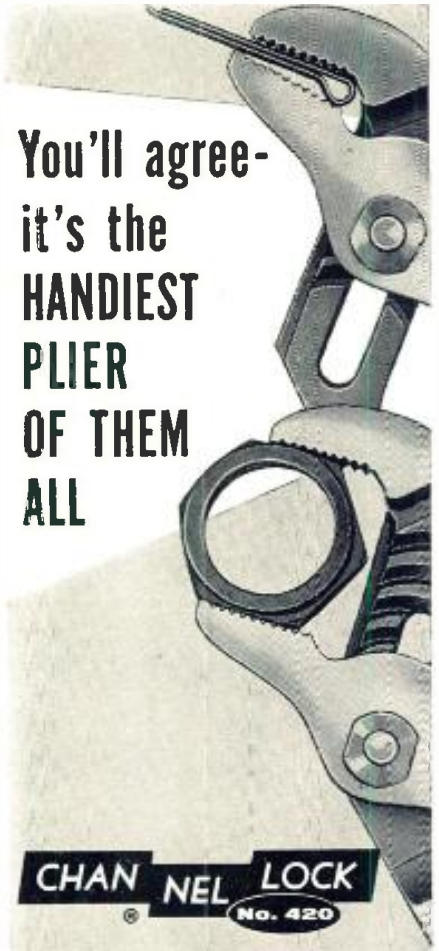

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TRADITIONALLY New Years is a time for assessing past performances and planning changes and improvements. In this respect magazines are like individuals since we, too, indulge in stock-taking and soul-searching and resolve to make each new year the best ever for our readers.

Unlike individuals, however, our "New Year's Resolutions" are the result of innumerable staff meetings and editorial consultations with our readers and our advertisers. From this array of opinion and information we have formulated our editorial policy for the coming year—and we think you will like it.

First of all, we are going to bring you a bigger and better magazine than ever before. Not only will we provide authoritative and timely articles on a wide variety of subjects but we will give you more of them and cover an even wider scope.

In addition, we plan to institute a series of "fold-outs" which will bring you a wealth of pertinent and valuable data in permanent, easy-to-retain form. Each of these "gatefolds," as they are known in the trade, will carry information you can use in your work or your hobby—in a form which facilitates mounting on your shop or hobby room wall or filing for safekeeping along with your service information folders. The first of these "gatefolds" will appear in next month's issue. This "Sound Chart" will include the "Fletcher-Munson curve," the frequency range of all musical instruments as well as that of the male and female voice, thresholds of hearing and feeling, sound levels of music and speech, etc.

The service technician will find more and more material designed to be of dollar-making and money-saving help to him in his day-to-day operations. The audiophile, whether professionally involved or an enlightened hobbyist, can look to this magazine for up-to-the-minute information on every facet of the field. We will keep you abreast of every new development in stereo—tapes and discs—and the equipment being produced to play them; of the progress in multiplexing, in FM networking, simulcasting, TV simulcasting for stereo—in fact every single thing the hi-fi fan wants to know.

The general reader who prides himself on keeping up with the world of electronics will find that his interests are being catered to as never before. Today's educated man is expected to be conversant with a multiplicity of topics not necessarily connected with his everyday bread-and-butter job. To amplify and round out the news coverage of important events—as provided by the daily papers and the weekly news magazines—we will bring you background material and full details on the equipment and techniques making their mark in our exciting world of electronics.

Physically, too, we are planning to increase the over-all attractiveness of the magazine by giving you a sturdier cover, changing some of our type faces for improved readability, and brightening up our layout of the articles. You will find more color in the magazine—used in new and interesting ways. Our "New Year's Resolutions" are designed to make this magazine your *Number One* source for all that is best and most authoritative in the field of electronics. We want you to come to rely on us for *all* the information you should have and want on what is going on in the fascinating and dynamic world of the vacuum tube and transistor—the World of Electronics!

Making such an expansion possible entails a number of unusual expenses which are not now covered by the subscription price of the magazine or the advertising rates. In this period of the 46-cent dollar the cost of physically producing any magazine (typesetting, printing, mailing, paper, and ink) has risen along with your grocery bill and the cost of every service you use. These increased production costs plus the expense of the new projects we have in store for our readers necessitate a modest upward adjustment in the newsstand and subscription prices of this magazine. The decision to raise our price was not taken lightly but the consensus was that our readers would rather have a top quality magazine which brings them ALL the information they want about the world of electronics than settle for less-than-the-best at a pre-inflation price.

Next month when you step up to your newsstand for your copy of the bigger, brighter, and better RADIO & TV NEWS the man will ask you for 50 cents for your favorite publication—but we sincerely believe that the additional pages, additional information, and wider scope of the magazine will have you agreeing that it is the "best half buck I ever spent!"

Limited space prevents our revealing all of our plans now—but next month we will tell you more about the important and exciting changes in store for you. See next month's "For the Record." —30—

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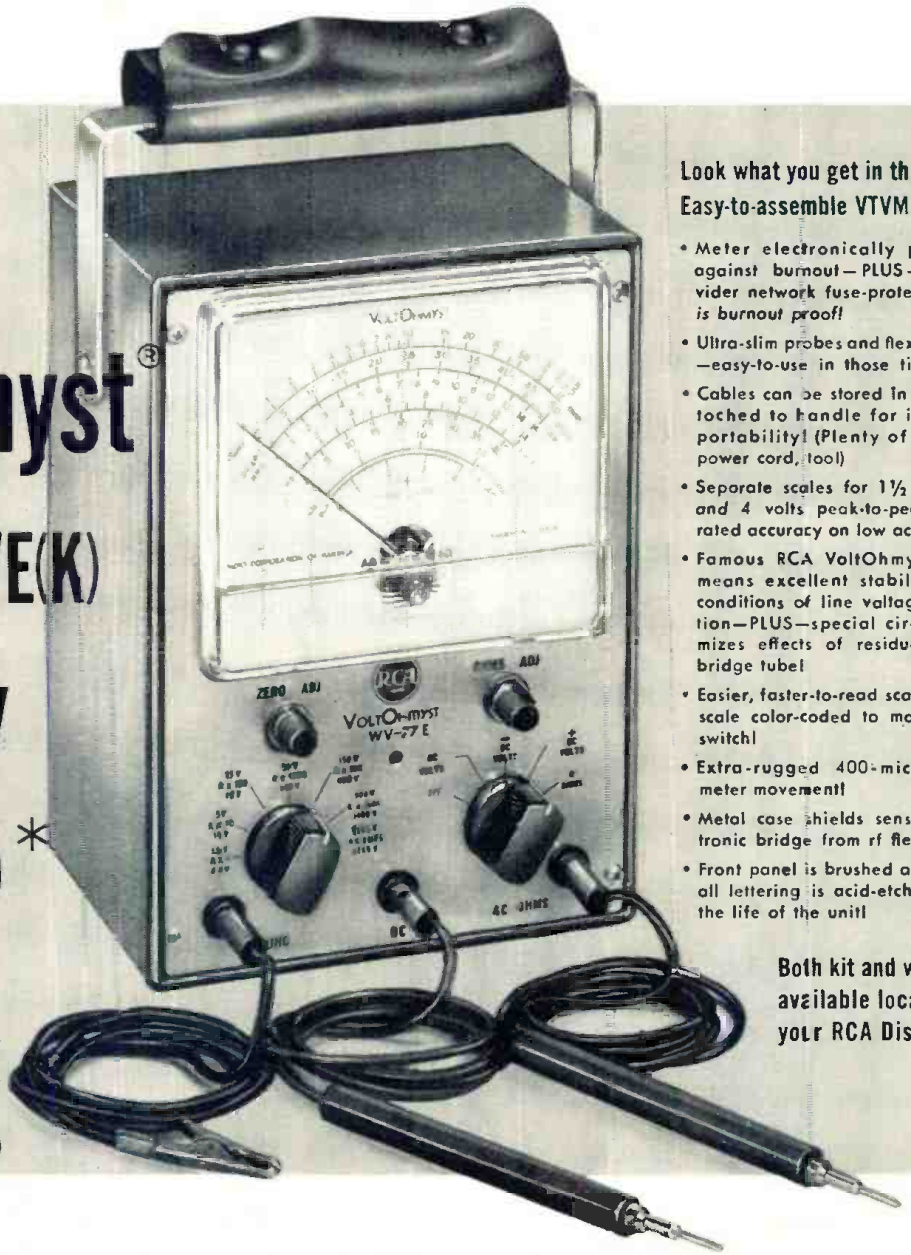

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WHAT IS IT?

To the Editors:

Here is a photograph of a piece of equipment which we have picked up in an old house. Can any of your readers tell us what the unit is? All we know is that it was made by *RCA*, and the

4-position switch in the center of the unit is labeled "frequency changer."

A. Gallo
Vision Radio & Television Service
Ford City, Pennsylvania

If any of our readers can identify this piece of equipment, we would certainly like to hear from them.—Editors.

* * *

FRENCH HI-FI AMPLIFIER

To the Editors:

I have just finished reading the article on the French 3-D hi-fi amplifier described in your July issue. Where can I get more information on this amplifier? I am very much interested in the circuit and would like to purchase a unit, if possible.

John J. Nalepa
RCA Mayaguez A. F. B.
Patrick A.F.B., Florida

To the Editors:

Your July issue was one of the best I have seen. How about more information on the French amplifier described?

B. K.
Baltimore, Maryland

For our many readers who have requested the name and address of the manufacturer of the French hi-fi amplifier, it is as follows: B.T.H. Cie Francaise, Tomson-Houston, *Group Petite Materiel, 173, Boulevard Haussman, Paris 8, France. We suggest you contact them directly for further information.—Editors.*

* * *

ASSOCIATION OF THE MONTH

To the Editors:

The Electronic Service Association is very grateful to Radio & TV News for extending to us the honor of being the "Association of the Month" in your September, 1958 issue.

We, who are so often forgotten by the TV manufacturers whose sets we repair and for whom we retain so much good will, wish to thank the editors and the publisher for the time and trouble it must have taken to write and edit such a very fine article.

I, as corresponding secretary, have been receiving compliments from everyone who reads the article as well as from members of ESA for sending the information on to you.

Howard C. Larsen
Corresponding Secretary
Electronic Service Association
Detroit, Michigan

We are pleased to know that you and your Association liked the coverage received in "Service Association of the Month." We certainly would like to invite all service associations to give us the opportunity of telling their story as well. Simply fill in the coupon which usually appears along with our coverage of the "Service Association of the Month."—Editors.

* * *

IGNITION ANALYZER

To the Editors:

I have received several letters concerning the lack of synchronization in the ignition analyzer described in the July issue. Actually, I should have foreseen the difficulty and warned of it in the article.

For example, assume a 6-cylinder automobile engine is idling at 300 rpm. Since each cylinder fires only once every two revolutions, we get 150 displays per cylinder a minute. This means that for a 6-cylinder engine, a scope's sweep must operate at 900 sweeps-per-minute or 15 sweeps-per-second. Many commercial scopes will not sweep at this slow rate.

There are two solutions to this problem. The first is to slow the sweep of the scope by adding an external capacitor. Many scopes have external jacks for such an addition. The second solution is to use the analyzer only at

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the engine speeds where the scope will sync properly. Since it is at the higher speeds where most ignition difficulties appear, this does not represent a handicap of the equipment.

DANIEL P. PETERS
Boonton, New Jersey

We have had quite a few letters concerning sync problems with this unit so that the above suggestions from the author of the article should certainly be useful.—Editors.

* * *

MULTIPLEX ADAPTER

To the Editors:

In the October issue of your magazine, there is an article on stereo broadcasting by M. Snitzer in which the topic of FM multiplexing is covered. I wonder if you could possibly send me a circuit of a multiplex adapter that would be suitable for use with this system.

D. McGOWAN
Willow Grove, Pennsylvania

To the Editors:

One of the good Washington FM stations, WASH-FM, is now broadcasting stereo on a daily schedule by the multiplex system, using a 67 kc. subcarrier. I would like to "get in on this," and would be very interested in seeing a construction article on a multiplex adapter.

EDWARD O. BASSETT
Silver Spring, Maryland

We are sure that all of our readers who are interested in FM multiplex will find some excellent and definitive information in the two-part series on the subject by Paul Hille, which begins in this month's issue. The second part of the series, which will run next month, gives complete constructional details on an FM multiplex adapter designed and built by the author. Because of the lack of standards for FM multiplex, it might not be too good an idea to proceed full speed with the project. However, for those who are interested, we will have complete information available.—Editors.

* * *

BACK ISSUES

To the Editors:

I am writing in an effort to obtain information which you may have covered in some of your back issues dealing with electrostatic loudspeakers. Can you help me?

VARNER L. PADDACK
Grand Forks, North Dakota

The above is typical of a good many requests we get for information contained in back issues of this magazine. For example, two such articles on the subject are "Electrostatic Loudspeakers—Questions and Answers" (June, 1958 issue) and "All About Audio and Hi-Fi — Electrostatic Speakers and Transient Response—Part 6" (October, 1957 issue).

Back issues of RADIO & TV NEWS *are available, commencing with the Febru-*

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What Does F.C.C. Mean To You?

What is the F. C. C.?

F. C. C. stands for Federal Communications Commission. This is an agency of the Federal Government, created by Congress in 1934 to regulate all radio communication and radio and television broadcasting in the United States.

What is an F. C. C. Operator License?

The F. C. C. requires that only qualified persons be allowed to install, maintain, and operate electronic communications equipment, including radio and television broadcast transmitters. To determine who is qualified to take on such responsibility, the F. C. C. gives technical examinations. Operator licenses are awarded to those who pass these examinations. There are different types and classes of operator licenses, based on the type and difficulty of the examination passed.

What are the Different Types of Operator Licenses?

The F. C. C. grants three different types (or groups) of operator licenses – commercial radiotelePHONE, commercial radioteleGRAPH, and amateur.

COMMERCIAL RADIOTELE*PHONE* operator licenses are those required of technicians and engineers responsible for the proper operation of electronic equipment involved in the transmission of voice, music, or pictures. For example, a person who installs or maintains two-way mobile radio systems or radio and television broadcast equipment must hold a radiotelePHONE license. (A knowledge of Morse code is NOT required to obtain such a license.)

COMMERCIAL RADIOTELE*GRAPH* operator licenses are those required of the operators and maintenance men working with communications equipment which involves the use of Morse code. For example, a radio operator on board a merchant ship must hold a radioteleGRAPH license. (The ability to send and receive Morse is required to obtain such a license.)

AMATEUR operator licenses are those required of radio "hams" – people who are radio hobbyists and experimenters. (A knowledge of Morse code is necessary to be a "ham".)

What are the Different Classes of RadiotelePHONE licenses?

Each type (or group) of license is divided into different *classes*. There are *three* classes of radiotelephone licenses, as follows:

(1) Third Class Radiotelephone License. No previous license or on-the-job experience is required to qualify for the examination for this license. The examination consists of F.C.C. Elements I and II covering radio laws, F.C.C. regulations, and basic operating practices.

(2) Second Class Radiotelephone License. No on-the-job experience is required for this examination. However, the applicant must have already passed examination Elements I and II. The *second class* radiotelephone examination consists of F. C. C. Element III. It is mostly technical and covers basic radiotelephone theory (including electrical calculations), vacuum tubes, transistors, amplifiers, oscillators, power supplies, amplitude modulation, frequency modulation, measuring instruments, transmitters, receivers, antennas and transmission lines, etc.

(3) First Class Radiotelephone License. No on-the-job experience is required to qualify for this examination. However, the applicant must have already passed examination Elements I, II, and III. (If the applicant wishes, he may take all four elements at the same sitting, but this is not the general practice.) The *first class* radiotelephone examination consists of F. C. C. Element IV. It is mostly technical covering advanced radiotelephone theory and basic television theory. This examination covers generally the same subject matter as the second class examination, but the questions are more difficult and involve more mathematics.

Which License Qualifies for Which Jobs?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain, and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain, and operate every type of radiotelephone equipment (except amateur, of course) including all radio and television stations in the United States, and in its Territories and Possessions. This is the highest class of radiotelephone license available.

How Long Does it Take to Prepare for F. C. C. Exams?

The time required to prepare for FCC examinations naturally varies with the individual, depending on his background and aptitude. Grantham training prepares the student to pass FCC exams in a minimum of time.

In the *Grantham Correspondence Course*, the average beginner with NO previous experience or training in radioelectronics should obtain his *second class* radiotelephone license after from 200 to 300 hours of study. This same student should then prepare for his *first class* FCC license in approximately 100 additional hours of study.

In the *Grantham Resident Course*, the time required to complete the course and get your license (under normal circumstances) is as follows:

In the DAY course (5 days a week) you should get your *second class* license at the end of the first 9 weeks of classes, and your *first class* license at the end of 3 additional weeks of classes. This makes a total of 12 weeks (just a little less than 3 months) required to cover the whole course, from "scratch" through *first class*.

In the EVENING course (2 nights a week) you should get your *second class* license at the end of the 22nd week of classes and your *first class* license at the end of 8 additional weeks of classes. This makes a total of approximately 7 months required to cover the whole course, from "scratch" through *first class*, in the evening course.

The Grantham course is designed specifically to prepare you to pass FCC examinations. All the instruction is presented with the FCC examinations in mind. In every lesson test and pre-examination you are given constant practice in answering FCC-type questions, presented in the same manner as the questions you will have to answer on your FCC examinations.

Why Choose Grantham Training?

The Grantham Communications Electronics Course is planned primarily to lead to an F.C.C. license, but it does this by TEACHING electronics. This course can prepare you *quickly* to pass F. C. C. examinations because it presents the necessary principles of electronics in a simple "easy to grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

Is the Grantham Course a "Memory Course"?

No doubt you've heard rumors about "memory courses" or "cram courses" offering "all the exact FCC questions". Ask anyone who has an FCC license if the necessary material can be memorized. Even if you had the exact exam questions and answers, it would be much more difficult to memorize this "meaningless" material than to learn to understand the subject. Choose the school that teaches you to thoroughly understand – choose Grantham School of Electronics.

Is the Grantham Course Merely a "Coaching Service"?

Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it presumes the student already has a knowledge of technical radio and approaches the subject on a "question and answer" basis. On the other hand, the Grantham course "begins at the beginning" and progresses in logical order from one point to another. Every subject is covered simply and in detail. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test so you can discover daily just which points you do not understand and clear them up as you go along.

HERE'S PROOF that Grantham Students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Wks.
Robert H. Moore, 807 Grace St., Baldwin, L.I., N.Y.	1st	12
Otis A. Towns, 3638 Bates St., St. Louis, Mo.	1st	12
Robert A. Herrman, 608 Walker Ave., Baltimore, Md.	1st	14
Walter Mengel, Jr., 423 James St., Crystal Lake, Ill.	1st	8
Serge G. Miller, 1315 W. 15th St., San Pedro, Calif.	1st	12
John A. Hayes, 1519 Madison Ave., Memphis, Tenn.	1st	14
Franklin A. VanLeuven, 6061 Woodlawn Ave., Maywood, Calif.	1st	12
Robert A. Morgan, 25 Barrow St., New York, N.Y.	1st	9

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ary, 1954 issue, from our Circulation Department, 434 South Wabash Avenue, Chicago 5, Illinois at a cost of $.40 each.—Editors.

* * *

AUDIO "MIX-IT" BOX

To the Editors:

I have had some correspondence with readers who are anxious to duplicate my audio "mix-it" box (September, 1958 issue).

One question that has come up is the identification of the various knobs that are on the front panel of the box. The four large knobs are, left to right, R_8, R_{11}, R_{27}, and R_{26}. A small screwdriver adjustment next to the meter is R_{23}. The two small knobs below are the "on-off" switch and R_{14}, the master volume control.

Another question has to do with whether a tape head could be used with the mix-it box. It might be possible to connect some tape heads to J_3. However, most heads require special equalization, which is not provided by my mixer. Therefore, a tape preamp would be needed.

Finally, some readers have wanted to know whether a microammeter could be used for M_1. It would be possible to use a 50-microampere meter, for example, with a series diode rectifier or a bridge rectifier ahead of it for this purpose.

LEON A. WORTMAN
New York, New York

We are glad to pass along Author Wortman's suggestions for those who are interested in constructing the mixer he described.—Editors.

* * *

COUNTING COIL TURNS

To the Editors:

Referring to the brief item "Counting Coil Turns" on page 134 of your October issue, I believe it would be easier to count the turns of the handle of the drill rather than its chuck. All you need to do is predetermine the gear ratio. For instance, the chuck on my drill turns 3¾ times for each turn of the handle, so when I want a coil of 300 turns, it is much easier to simply count 80 turns of the handle.

LAWRENCE DAVIS
Columbus, Ohio

Reader Davis' suggestion is a good one, provided the relation between the handle turns and the chuck turns is fairly simple. Just as soon as some fractions start to enter the picture, the additional calculations involved and the resultant lack of accuracy may make it easier just to turn the drill more slowly and count the turns made by the chuck.—Editors.

* * *

7½ IPS 4-TRACK STEREO TAPE

To the Editors:

I was very interested in the articles "Stereo Tape or Disc?" and "Behind the Stereo Scene," which appeared in your October issue.

I have had quite a bit of experience with tape recordings made at 3¾ ips,

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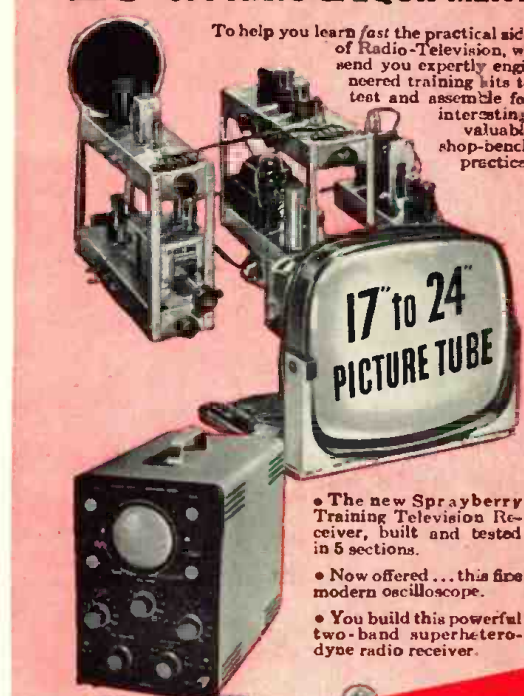

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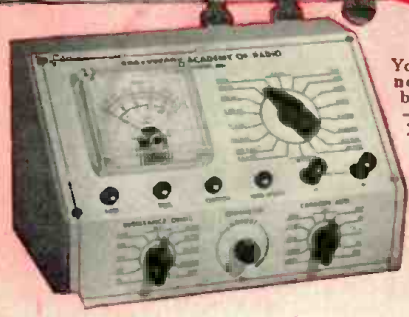

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The Engineering Staffs of

H. H. Scott and London Records Introduce the new

ffss matched stereophonic arm and cartridge

"...in a class apart from all the others..."

— *Saturday Review, September 27, 1958, Page 46*

The *Saturday Review* went on to say: " . . . the new (London-Scott) FFSS pick-up emerged as easily the outstanding stereo pick-up to be seen at Earl's Court (London, England High Fidelity Show) . . . Only (this) pick-up is of quality to satisfy the exacting demands of most Hi-Fi addicts. This is a really first-class piece of design and, moreover, of great flexibility since, in addition to the normal pair of 45/45 coils, it contains a third coil which enables it to be used for monaural, single-channel performance . . . The (London-Scott's) performance does place it in a class apart from all the others, and its price . . . is by no means excessive for an instrument of its class".

1 The Type 1000 is a completely matched arm and cartridge system designed to give optimum performance from wide frequency range recordings. 2 This integrated design minimizes tone arm resonance problems and assures proper alignment of stylus on record. This is extremely important when stereo-disks are played as it keeps cross-talk to almost unmeasurable levels (cross-talk-20db). 3 Extremely low tip mass (less than 1 mg.) reduces record wear to an absolute minimum and assures accurate tracking even at high volume levels. This tip mass is at least 50% lower than cartridges of conventional design. 4 Frequency response 20 CPS to 20,000 CPS. This extended response is far beyond the range of ordinary pickups. 5 High vertical compliance of this pickup minimizes record wear and prevents damage even if cartridge is dropped on record. 6 Tracking pressure 3.5 grams for optimum response and minimum wear. 7 Output 4 millivolts. 8 Stylus tip of polished diamond, 0.5 mil radius. This small radius assures minimum distortion. 9 Length of arm from pivot to stylus 12.5", Height of arm adjustable. 10 Frictionless precision roller bearings minimize lateral tracking force. 11 Performance of this pickup on monaural records is superior to conventional monaural pickups because of the extremely low mass and extended frequency response. Price of arm and cartridge assembly: $89.95.

LONDON ffss

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h.h. Scott

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and I have found that many tape recorders develop quite a bit of wow at this speed after prolonged use. On the other hand, 7½ ips stereo tapes with just two tracks are too expensive today. Therefore, I think the solution to the tape dilemma is to use the higher speed but go to four tracks. So, how about some manufacturers thinking over the idea and coming out with recorded stereo tape that runs at 7½ ips, but which has four tracks on it. In this way, we will get tape economy and high quality too.

EGON E. ECKERT
Danbury, Connecticut

The arguments expressed by Reader Eckert certainly have merit. On the other hand, there is enough confusion in the tape market today so that the proposal of still another standard might not make too much sense. The fact remains, however, that the new, smaller heads that are suitable for four-track stereo ought to result in still better performance at 7½ ips than the lower-speed machines for which they were designed.—Editors.

* * *

TRANSISTOR SUPERREGEN FM TUNER

To the Editors:

When I came across the article on the transistor superregen FM tuner in the November issue, I was all enthused and ready to build it, that is, until I saw the price of the 3N25 tetrode transistor. My catalogues list this little item at $16.00. This price, in conjunction with the cost of the zener diode, transformer, and other components, probably make the cost of this project well over $25.00.

KENNETH GREENBERG
Chicago, Illinois

Our article carefully mentioned the prices of all special items, and indicated that the total cost would not exceed $25.00. However, according to the information available to the author at the time the manuscript was written, the 3N25 sold for $12.50. According to the latest catalogues, the price is now $16.00 so that Mr. Greenberg certainly appears to be right. The tuner would still be of interest to anyone who wants to experiment with the new tetrode transistor and who wants a simple circuit that works well. However, we certainly must warn our readers of the cost.—Editors.

* * *

SUPREME ROLL CHARTS

To the Editors:

Can you supply me with a roll chart or reprints of articles for use with a Supreme Model 504A tube tester for newer type tubes?

WILLIAM WEBB
Bellevue, Washington

The Supreme line of tube testers is no longer in production, and we know of no source from which up-to-date roll charts are available. However, we are planning a 2-part article telling owners of older tube testers how they may be able to set up these instruments for testing newer tube types. —30—

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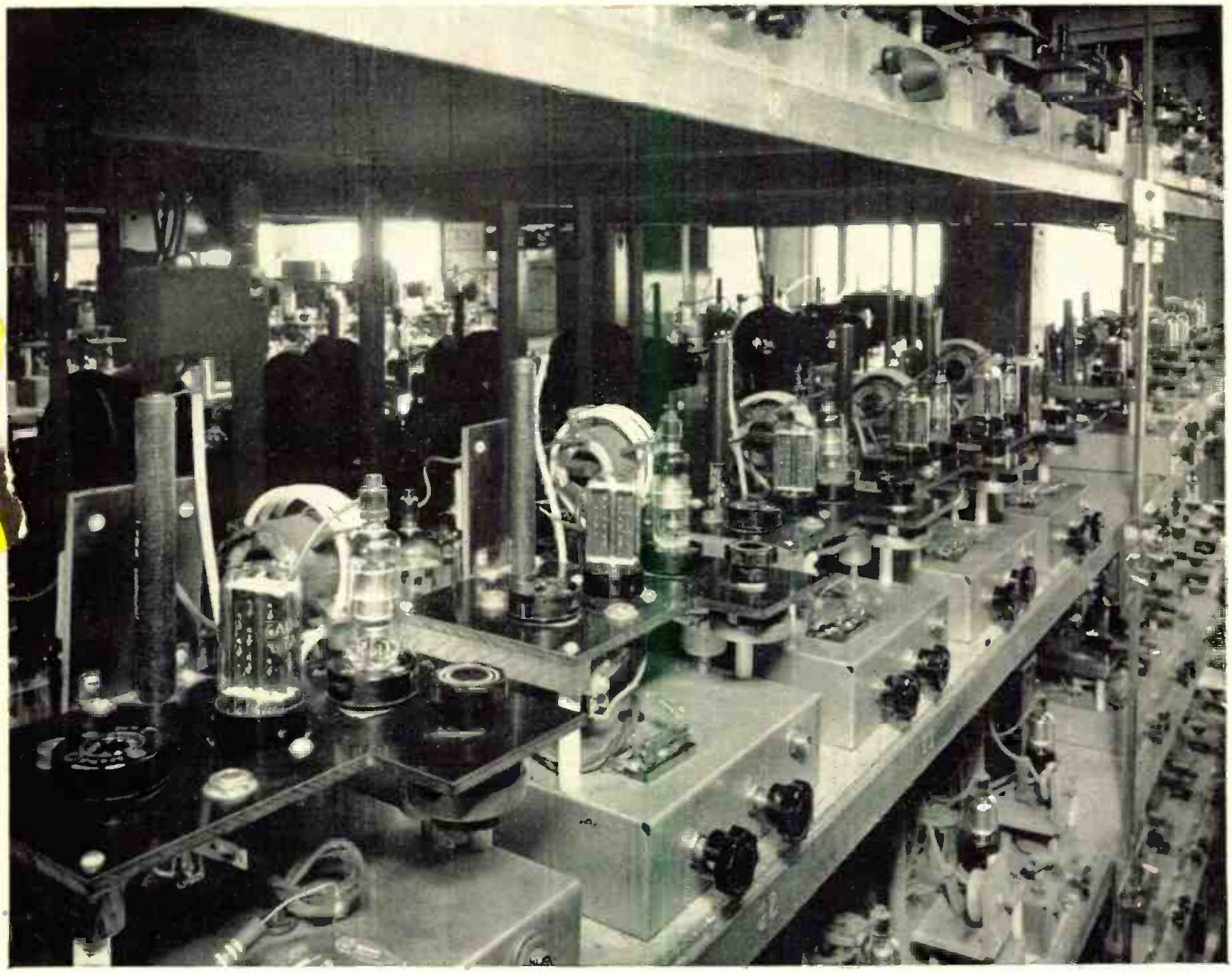

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Within the Industry

DR. PHILIP N. HAMBLETON has been appointed supervisor of research and development, tubes, for *CBS-Hytron*, a division of *Columbia Broadcasting System, Inc.*

Dr. Hambleton was previously senior physicist in the tube research and development laboratory. Prior to joining the firm he was associated with *Sylvania Electric Products* and *Philco Corporation*. In addition, he served as supervisor of *Superior Tube Company's* electronic laboratory.

He received his Doctorate in Physics from The Johns Hopkins University, and is a member of the Institute of Radio Engineers, the American Institute of Physics. and the American Physics Society, among others.

* * *

HARRY L. BRYANT, vice-president and chief engineer at *Radio Recorders,* Hollywood, Calif., has been elected executive vice-president of the Audio Engineering Society.

Mr. Bryant is the first westerner ever to hold post in the association, the only national engineering society devoted exclusively to audio technology. He is a fellow of the organization and served previously as western vice-president.

* * *

HAROLD J. ADLER has been named vice-president in charge of operations at *Shure Brothers, Inc.* In this capacity he will be responsible for all engineering and manufacturing activity at the company.

A licensed engineer and a senior member of the Institute of Radio Engineers, Mr. Adler was graduated in 1930 from Armour Institute. now part of the Illinois Institute of Technology, Chicago.

He was chief electrical engineer of the *Sentinel Radio Co.* for 17 years and was director of engineering of the *Hallicrafters Co.* for five years. Mr. Adler also was vice-president of *Edwin I. Guthman Co.* and for the past three years has been a private consultant to industry on engineering, manufacturing, and sales.

* * *

COMPONENTS CORPORATION announces the formation of its Nuclear Instrument Division. Jerry B. Minter will be in charge of this new division . . . The entire master television antenna business of **AMY, ACEVES AND KING** has been acquired by **AMPLITEL INCORPORATED.** The purchase includes patents and all existing contracts for service and future installations . . . **DI-AN CONTROLS, INC.** has been formed in Boston, Mass. Products planned include magnetic logical elements, shift registers, special purpose computers, industrial control systems, digital storage systems, and servo amplifiers.

* * *

SID N. COTTIN has been appointed show director for the Institute of High Fidelity Manufacturers.

He was formerly sales and advertising manager for *Crest Records* and *Shelley Products Ltd.* Previously he had been an advertising and printing consultant.

Mr. Cottin will be responsible for the handling of all Institute-sponsored shows throughout the country.

* * *

WALTER L. BROUGH has been named manager, manufacturing division, of *ORRadio Industries, Inc.*, a new position with the company.

Prior to joining the firm Mr. Brough was associated with *Hercules Motors Corp.* as executive vice-president. He was also chief engineer, *Union Drawn Steel Div., Republic Steel Corp.*, and spent many years with *Timken Roller Bearing Company.*

Mr. Brough is a graduate of Fenn College, Cleveland, Ohio and saw service in the Navy during the Second World War. He is a member of the American Society of Mechanical Engineers.

* * *

E. LEON CHAFFEE is among those named to receive a 1959 award from the Institute of Radio Engineers. He is to receive the "Medal of Honor," the highest technical award in the radio-electronics field. for "his outstanding research contributions and his dedication to training for leadership in radio engineering." Dr. Chaffee is the former director of the Cruft Laboratory, Harvard University and is Rumford Professor of Physics, Emeritus, and Gordon McKay Professor of Applied Physics, Emeritus.

In addition. the Morris Liebmann Memorial Prize will go jointly to Charles H. Townes, Professor of Physics, Columbia University, and Nicolaas Bloembergen, Gordon McKay Professor of Applied Physics, Harvard University.

Jack W. Herbstreit will receive the

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—Gerald L. Jellis, Watertown, So. Dak.
(Operator of "Radio TV Center")

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—Dan M. Heinrich, *Westlake, Ohio*

PENNSYLVANIA
"PHOTOFACT is an invaluable 'piece of equipment' in our repair shop and it speeds our shop repairs 100%."
—Luther W. Wilkes, *Houtzdale, Pa.*

NEW JERSEY
"PHOTOFACT is used here every day, like an extra brain."
—Joseph M. Decker Jr.
Newton, N. J.

MASSACHUSETTS
"I would be lost without PHOTOFACT."
—Emilio Conzo, *Newton, Mass.*

MAINE
"Having data on sets plus parts listings, etc., means the difference between getting sets fixed and out in a reasonable length of time or having them tied up while securing such information, as I am located in a small town and have to depend on mail service for parts and information."
—Samuel S. Sawyer,
Kezar Falls, Maine

VIRGINIA
"I don't know how we would get along without PHOTOFACT, as we work on all makes and models."
—Kenneth E. Jenkins,
Big Stone Gap, Va.

CALIFORNIA
"With PHOTOFACT, the information I need is always at hand. I don't have to worry about a repair job because I know I will have a schematic that gives me correct information in the simplest possible form."
—J. R. Stukes, *Norwalk, Calif.*

WISCONSIN
"In my business, I service all makes of TV sets. Without good service literature such as PHOTOFACT, this would be an impossible task—especially to do a quick, intelligent job. In my estimation, Sams PHOTOFACTS is unequalled. I would hate to conduct a business without them. Keep up the good work!"
—Willard F. Dumke,
Menasha, Wis.

ILLINOIS
"PHOTOFACT makes it possible to identify any part in any model TV...It is possible to locate trouble in almost any set through the use of Sams."
—Sam Rogondino, *Lake Forest, Ill.*

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Harry Diamond Memorial Award and the Vladimir K. Zworykin Television Prize goes to Paul Weimer of *RCA Laboratories*.

These awards will be presented at the 1959 IRE National Convention to be held in New York City next March.

* * *

DR. ALFRED N. GOLDSMITH has been elected to the board of directors of *RCA Communications, Inc.*

Dr. Goldsmith joined the parent company in 1919 and for 12 years served as director of research and then vice-president and general engineer. Since 1931 he has served as a technical consultant to the company.

He has been president of the Institute of Radio Engineers and the Society of Motion Picture and Television Engineers. In addition, he is a Fellow of the American Institute of Electrical Engineers, the Institute of Radio Engineers, the Acoustical Society of America, and the American Association for the Advancement of Science, to mention just a few.

Among Dr. Goldsmith's citations are the Medal of Honor and Founders Awards of the IRE, the Progress Medal Award of the SMPTE, and the Modern Pioneers Award.

* * *

ELECTRONIC INDUSTRIES ASSOCIATION's tube and semiconductor division is now operating the EIA Standards Laboratory, 32 Green St., Newark, N. J.

The new agency performs test measurements for tube and semiconductor manufacturers of the Association in connection with the recommendations of the appropriate Joint Electron Tube Engineering Council committees, and operates under the direction of the Association's engineering department with supervision by the executive committee of the tube and semiconductor division.

G. F. Hohn will head the Laboratory's operations.

* * *

KENNETH C. MORITZ has been named sales manager of the semiconductor division for *Raytheon Manufacturing Company* . . . **C. R. (RUSS) ROBERTSON** has been elected vice-president, sales, at *Weller Electric Corp.* . . . The appointment of **G. W. TUNNELL** to the post of manager, broadcast, systems, and shop repair service sales, has been announced by *RCA Service Company* . . . **AARON NEWMAN** has been appointed chief engineer of *Lafayette Radio's* kit division . . . **JAMES A. HANNAN** is now manager of the international division of *Centralab*, a division of *Globe-Union, Inc.* . . . *Conrac, Inc.* has named **CHARLES V. DICKMAN** national sales manager for the firm's "Fleetwood" products . . . The appointment of **F. J. VAN POPPELEN** as sales manager of *Motorola's* semiconductor

(*Continued on page* 103)

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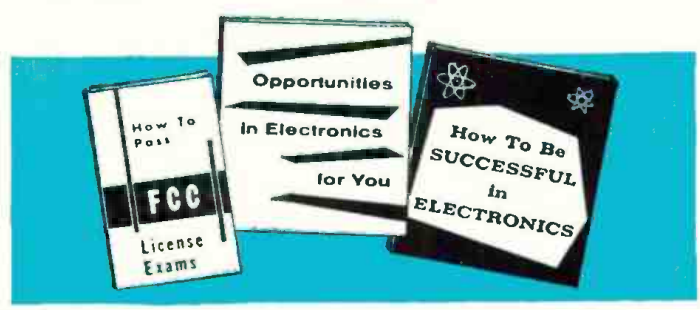

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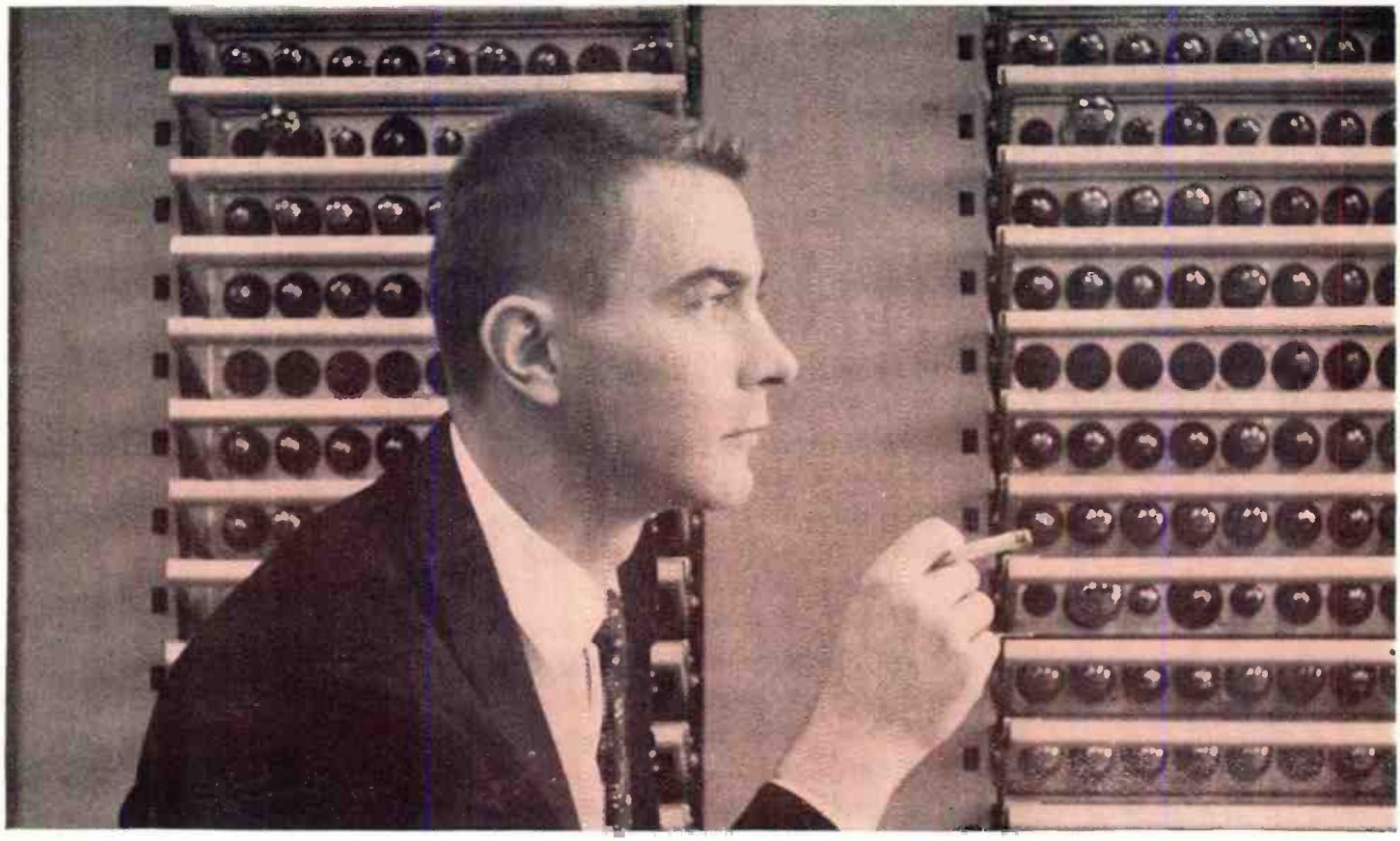

How far can you go in electronics . .

"Just being called a Field Engineer—an impressive title for a man without a degree—that really gives me a lift."

This is Jim Pieratt talking. With a high school education and Navy Technical training behind him, Jim holds a key job in one of America's most important electronic projects. He's an IBM Computer Units Field Engineer on Project SAGE.

Jim is 25, lean, crew-cut and soft-spoken. He smiles modestly when you ask him about his accomplishments. We were curious to know whether he had been technically inclined when he was a youngster.

"The truth is that I didn't become interested in electronics until I joined the Navy," says Jim. "Before that, the only technical thing I might have done was to take a couple of alarm clocks apart. I chose electronics in the Navy because I thought there was a future in it."

Change of attitude

"A lot of fellows may think, as I did, that a computer is too complicated for anybody but an Einstein to understand. It's not so. Even the largest computers like SAGE, which occupies space equivalent to a city block, can be comprehended by the ordinary man. But I didn't know this when I went for my employment interview—and I wondered if the algebra and trig I'd taken at Kalamazoo Central High would qualify me. Then my interviewer told me a little about computers . . . how they work and what my job would be after I finished IBM school. I made up my mind right then; I wanted this job."

Training school

Soon, Jim and 21 other fellows like himself started training in Kingston, New York, getting on real intimate terms with IBM's electronic giant. Marvel of complexity though it is, when it sits on the floor and you study it part by part, the computer loses its mystery. Little by little, you begin to understand the whole from the sum of the components.

"The 25 weeks I spent in training were very happy," says Jim. "It's interesting all the way. They encourage you to think for yourself and you're rewarded for your effort. Field Engineers can merit salary increases based on school performance."

Strategic job on Project SAGE

Jim is stationed in Virginia, near Richmond. His duties include installing, checking and testing out computer units. The giant electronic computers are the very heart and mind of Project SAGE (Semi-Automatic Ground Environment). To the in-put section of the computer comes data from radar sites, ships, reconnaissance planes and ground observer posts throughout the country. The display consoles give a visual representation of the complete air defense situation. Jim's prime responsibility is to keep the display consoles running.

8 pleasant hours a day

"I'm essentially my own boss and I'm encouraged to think for myself. For me, this is an ideal environment.

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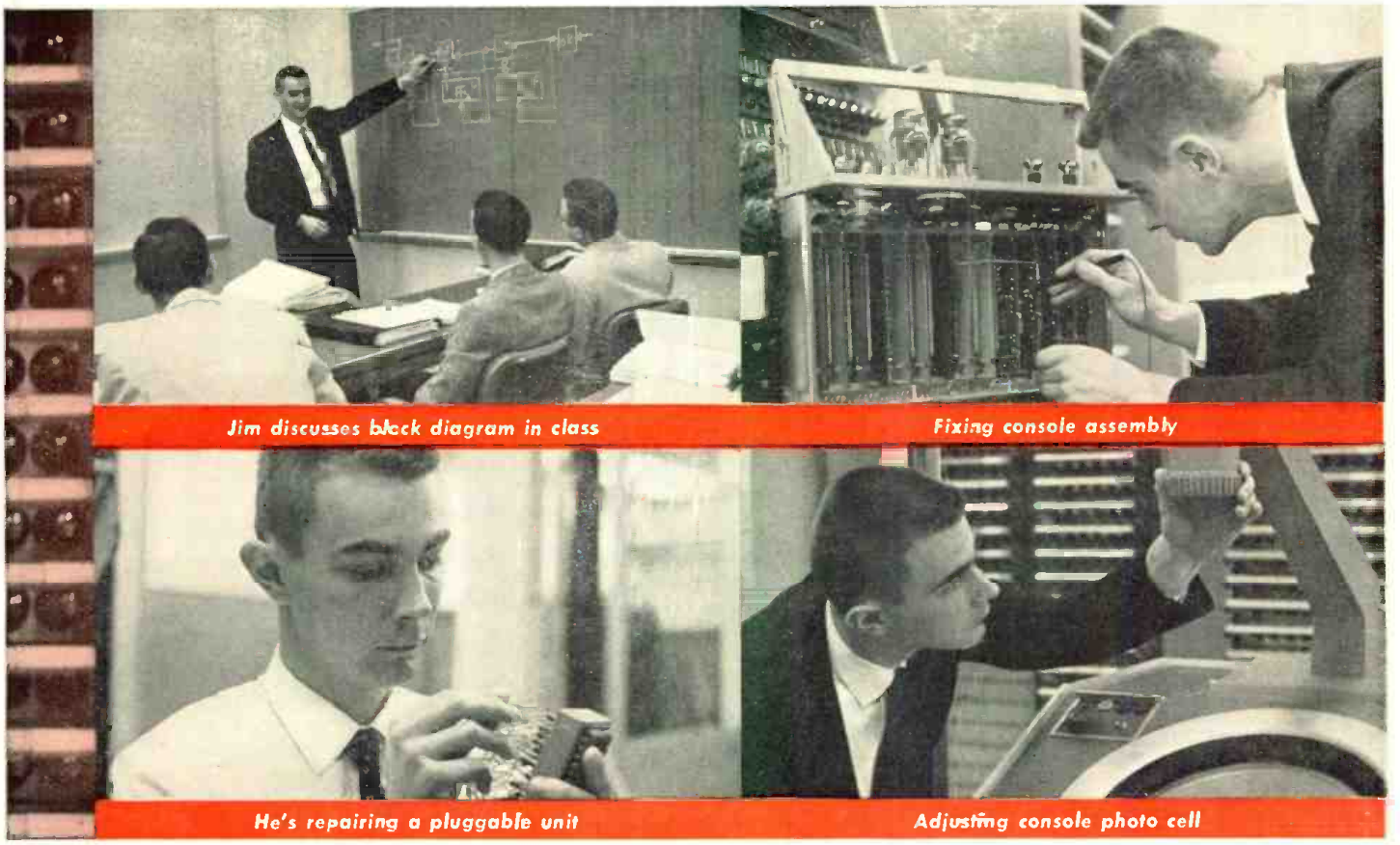

Jim discusses block diagram in class

Fixing console assembly

He's repairing a pluggable unit

Adjusting console photo cell

. without a degree?

What do I like best about my job? Trouble-shooting, I think. I enjoy being able to repair anything that isn't working properly. As a Field Engineer, I have opportunities to assume other engineering functions. For instance, while I have nothing to do with design engineering, I do suggest changes for review by the Design Engineers. I also rewrite engineering procedures."

Where do you go from here, Jim?

"There's plenty of room for me to grow at IBM. My next step up should be to Systems Engineer. This calls for more headwork. After that, if I display enough initiative, I may become a Group Supervisor."

Family, friends, recreation

Jim, his wife and three-year-old daughter live in a pleasant ranch home, just a few miles from the site. Social life? "We've made quite a few friends here," says Jim. "Mostly among the IBM fellows and their wives. We play golf together."

Where do you go from here?

Can you look ahead, as Jim Pieratt does, and see yourself as a man on the way up? Maybe you should give some thought to IBM Military Products and the Project SAGE program. Opportunities are greater than ever. IBM's long-range program will continue to grow in importance and vast sums will be invested in hiring the right men to accomplish its vital objectives.

If you have a minimum of 3 years' technical schooling—or equivalent experience—you may be eligible for advanced training for 5 months as a Computer Units Field Engineer. While training, you receive full pay plus living allowance before assignment to a permanent location. You are paid a salary, not hourly wages, plus overtime.

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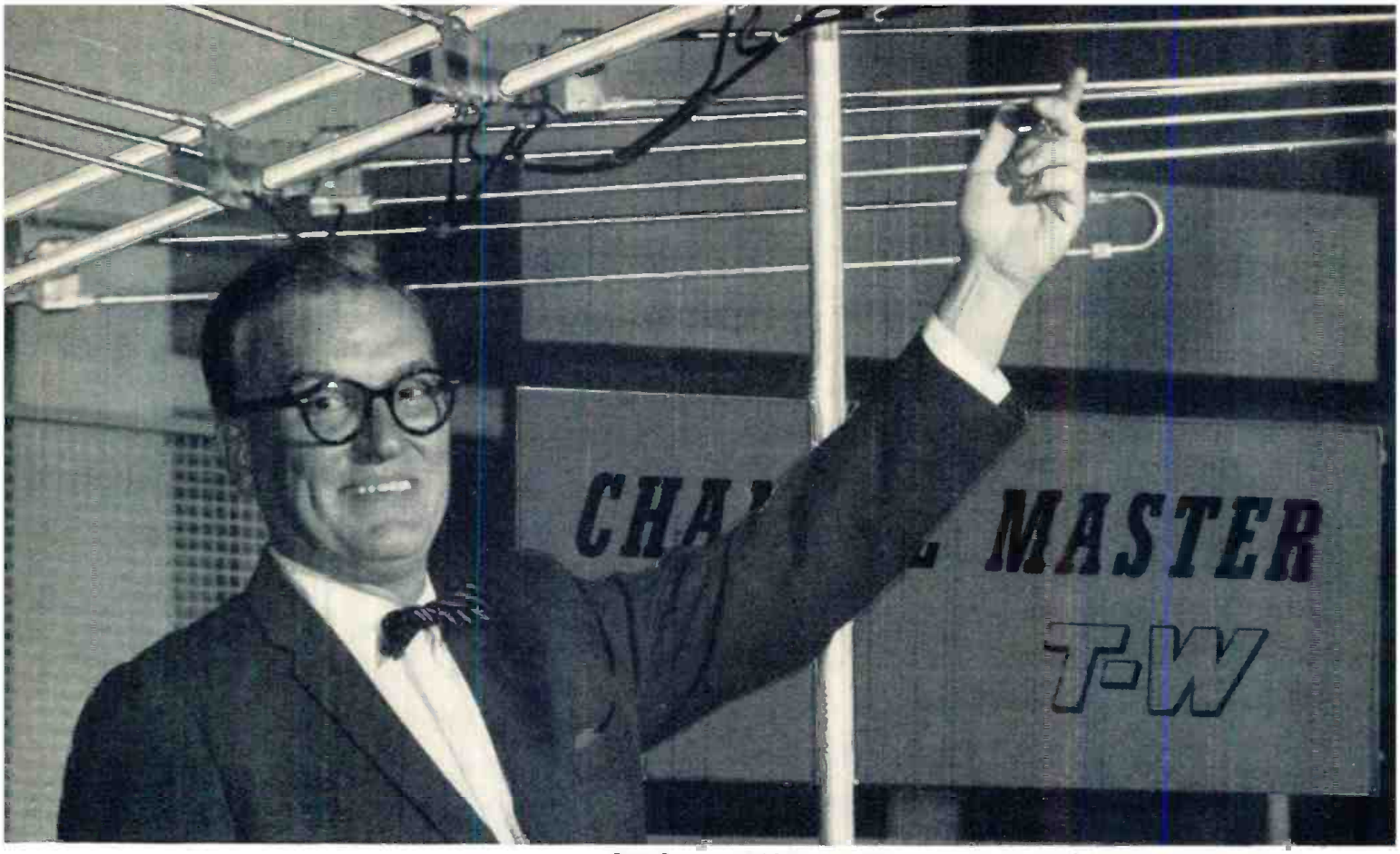

Dave Garroway, NBC-TV star, tells his viewers to replace their old antennas with T-W's.

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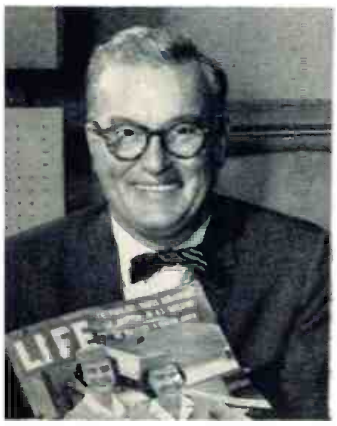

There are millions upon millions of over-aged, obsolete antennas in use today — providing weak TV reception for their owners. **These antennas must be replaced immediately** — and that's just what Channel Master has been telling the public in a no-punches-pulled ad campaign. We're also telling them that the best way to get good, clear reception and more years of peak performance is to replace their old antennas with Channel Master T-W's — the word's most powerful and largest-selling fringe area antennas.

We've wheeled advertising's Big Berthas onta the firing line for this campaign. Leading the barrage is Dave Garraway on his "Today" show, with 134 NBC-TV stations from coast-to-coast. This is the first time that network TV has ever been used to advertise antennas. A battery of 6 top consumer magazines — LIFE, SATURDAY EVENING POST, LOOK, TV GUIDE, FARM JOURNAL and PROGRESSIVE FARMER — also takes aim on the antenna replacement target.

CHANNEL MASTER CORP.

ELLENVILLE, NEW YORK

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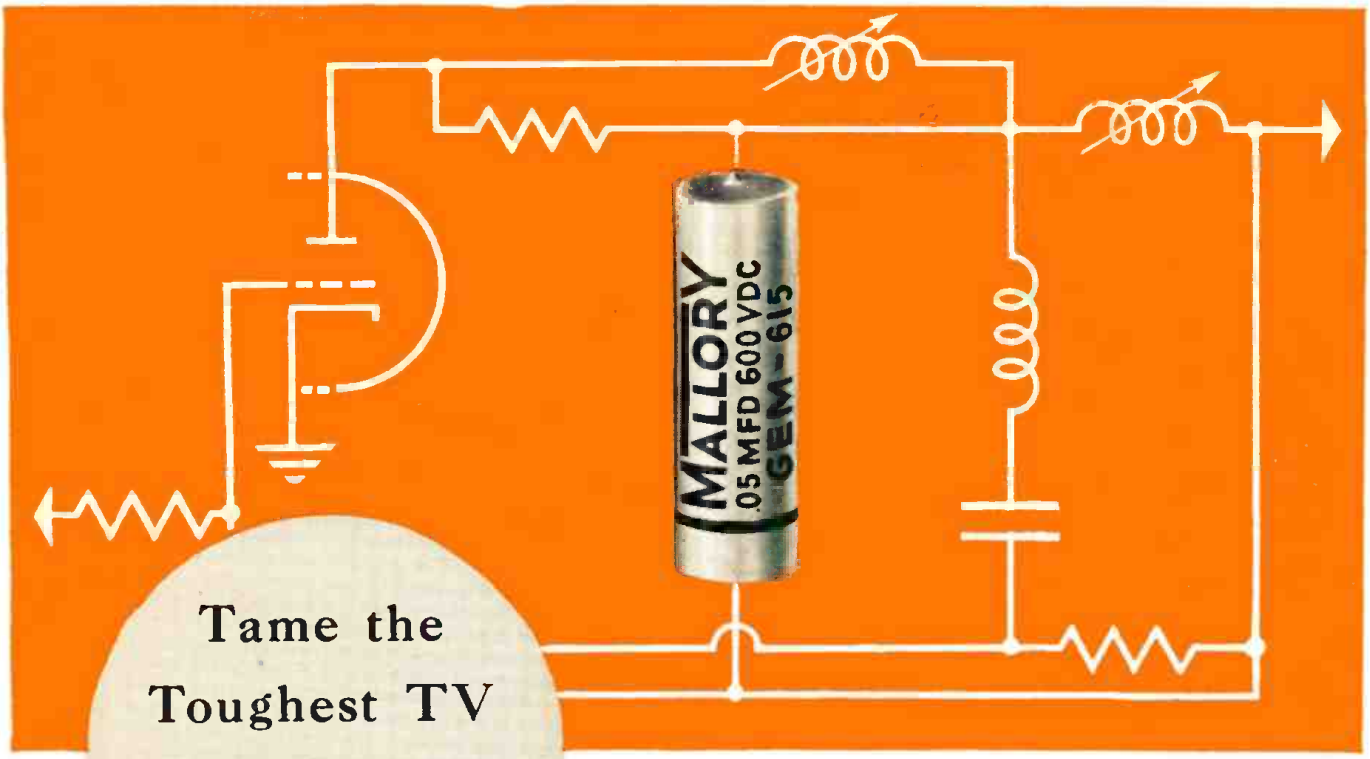
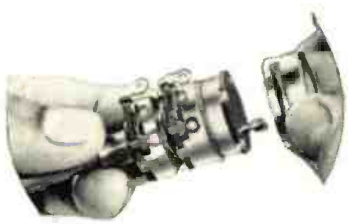


Tame the Toughest TV Replacement Spot with a . . . Mallory Gem Capacitor

This circuit should be familiar—half of a 6SN7 serving as the horizontal oscillator in a typical TV receiver circuit. The marked spot in the diagram is a tough assignment for a capacitor. If it opens, you lose raster. If it changes capacity, or if the replacement is beyond tolerances, the horizontal sweep will not sync in.

When replacing this capacitor, always use a Mallory Gem. It's moisture-proof—won't drift in capacity or internal resistance. Conservative voltage ratings guarantee reliability—in this, or any circuit. Get Gems today from your Mallory Distributor in the handy 5-pack.

FP Capacitors—the original 85°C filter



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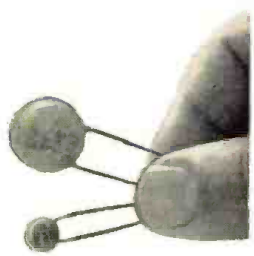

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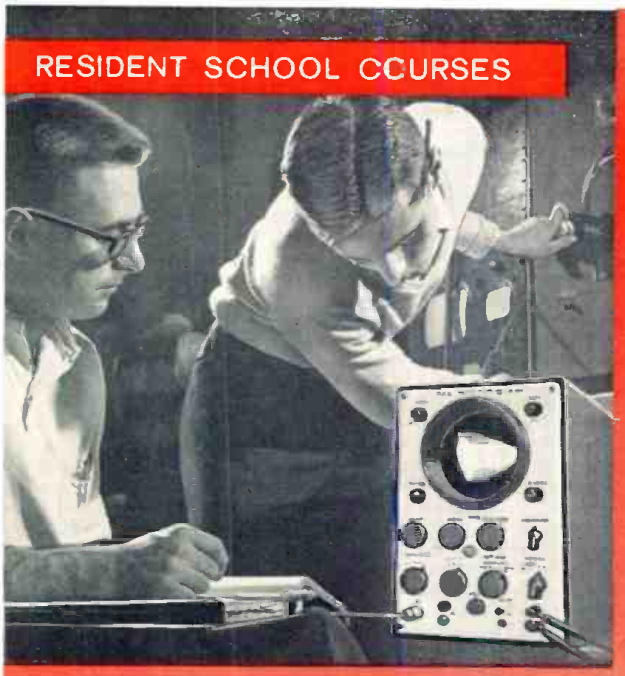

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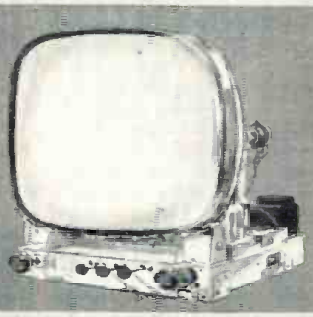
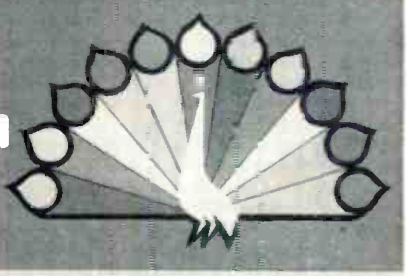


course III

Color Television



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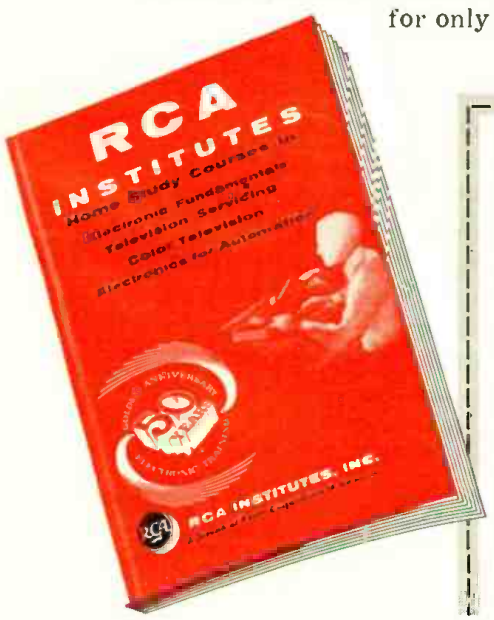

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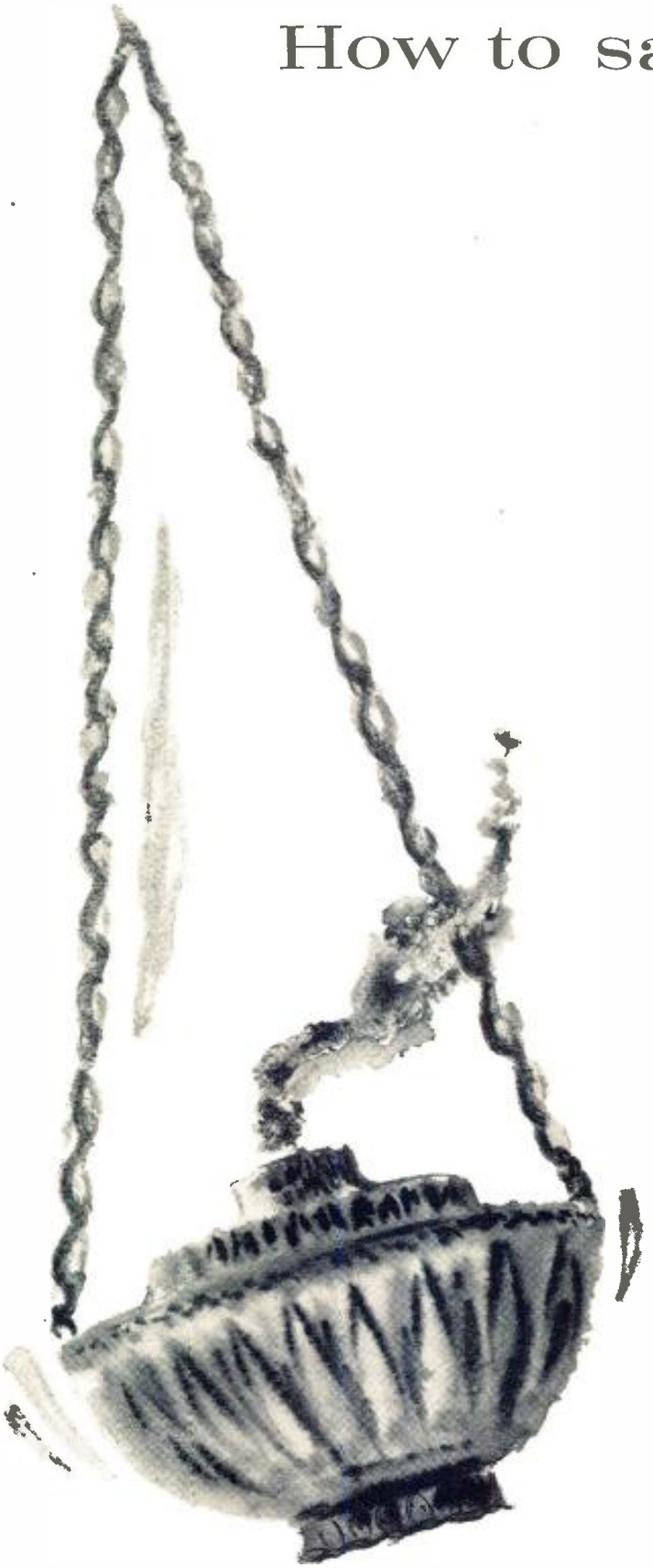
How to save 77 years



The boy Galileo sat in the sanctuary of Pisa's great cathedral, observing the movement of a lamp which had been set swinging by a sudden gusty draft. The chain by which it was suspended from the high ceiling was of such a length that the arcs decreased but slowly. Strange thing, though. No matter how far the pendulum swung, its movement consumed the same time. Galileo made a note of that. The year was 1581.

The old man sat at his writing desk, sixty years and a thousand disputes later, writing down a new theory. The regularity of a swinging pendulum might be combined with a spring mechanism to improve the unreliable clocks of that day. So Galileo scribbled on and did nothing more about it. A number of years after his death Huygens took the notes and invented the pendulum clock. *Seventy-seven years had elapsed since the boy made the observation upon which it was based!*

The creative thinker today still need not have a specific use in mind when, by equation or formula, he branches off from the accepted to the hitherto unknown. The classic invention of this decade, the transistor, evolved in the Bell Telephone Laboratories as scientists sought a deeper understanding of semiconductors. On the other hand, another great invention, the feedback amplifier, came from the acutely creative mind of one Bell engineer faced with a specific problem.

Current Bell Laboratories activities—in such areas as data transmission, radar and submarine cable development—call for the coordinated efforts of all types of thinkers and all types of approaches. One type complements another.

Today, seventy-seven years would not have elapsed between the swinging lamp and the swinging clock pendulum—certainly not at Bell Labs, where ideas, though not rushed, are carefully advanced toward fruitful application in national defense, industry and communications. An important part of this harvest is the efficiency of America's telephone service, unequalled anywhere else in the world.

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Spot News

Latest Information on the Electronic Industry

By RADIO & TV NEWS' WASHINGTON EDITOR

TV TO JOIN TELESCOPES IN STRATOSPHERE BALLOON FLIGHTS—A new role for television in high-altitude astronomy is now being blueprinted by the National Science Foundation and the Office of Naval Research. The program calls for linking of a TV system to remote-controlled balloon-mounted 12 and 36-inch telescopes which will probe celestial objects 80,000 feet above the earth.

THREE-DIMENSION RADAR DEVELOPED FOR ARMY—A three-dimensional transistorized radar which detects airborne targets at extreme range and for the first time simultaneously computes distance, bearing, and altitude, has been announced by the Department of the Army. Called "Frescanar", the new technique, developed by the Hughes Aircraft Company, Fullerton, California, is the eye of a "missile monitor", an Army air defense guided-missile fire distribution system for mobile use with a field army. Citing five basic advantages of the system over conventional radars, Army spokesmen said that "Frescanar" concentrates all available power in sharp pencil beams of energy flashing on and off in fan-shaped array to pinpoint targets at great distance with extreme accuracy; uses a single antenna and operator—conventional systems need two or more radars, operators, and master consoles to achieve similar results; computes range, bearing, and altitude at the same time; provides greater speed—all three types of data (range, bearing, and altitude) are transmitted to missile batteries, helping them to direct missiles on targets more rapidly; and sees targets more clearly. For more information and pictures, refer to page 69.

NO PAY-TV APPLICATIONS FILED THUS FAR WITH COMMISSION—According to FCC Commissioner Robert T. Bartley no request for subscription TV service has as yet been received in Washington, and it appears as if the whole problem will have to be resolved by the Congressional committees now investigating the situation.

N. Y. INDUSTRIAL ELECTRONIC FIRMS CITED FOR LICENSE-INTERFERENCE VIOLATIONS—Two New York industrial electronic companies specializing in r. f. heating equipment have been ordered by the FCC to cease and desist from violating Part 18 of the rules by operating equipment which is neither licensed nor certified by a qualified engineer or the manufacturer and which is causing interference to TV and radio service in the New York City area.

CLOSED-CIRCUIT TV PROVIDES INSTRUCTION ON GUIDED MISSILES—Telecasting of a two-hour course on guided missiles over a 280-mile closed-circuit has been inaugurated from the U. S. Army Ordnance Guided Missile School at the Redstone Arsenal, Huntsville, Alabama, to the U. S. Army Armor School at Fort Knox, Kentucky. The courses deal with the maintenance of six Army missiles: Nike-Ajax, Nike-Hercules, Corporal, Lacross, Hawk, and the Redstone. Cameras have been set up to make pickups from five locations and provide images to screens that measure 6' by 8'.

STEREOPHONIC BROADCASTING UNDER STUDY BY FCC—The Commission has invited comments on the use of stereophonic techniques by TV, AM, and FM broadcasters. In the past, most test broadcasts have been by jointly operated AM and FM stations in the same locality reproducing the same program on their respective channels. Combination TV-AM or TV-FM broadcasts are now being demonstrated. Also a limited number of FM stations are experimenting, under a developmental authority granted by the Commission, with dual FM channel transmission—one on the regularly assigned channel and the other on a multiplex subchannel. In this system only one receiver is required but a special adapter is necessary to extract the sound from the multiplex subchannel. -30-

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You know, yourself, how comforting it is to see a familiar face among strangers. Well, to the majority of your customers, TV *is* strange, too. They don't understand it. They count on you to "keep 'em going". And, the "familiar face" is the famous RCA monogram. When they see it on that famous red/black carton, *they* know *you* know your business . . . and use the best replacement tubes and parts money can buy.

You can cash in on the built-in prestige of RCA. Make this best-known name your stock-in-trade. Your Authorized RCA Tube Distributor handles a complete line of RCA Tubes to meet your service needs.

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Stereo Preamplifier HF85

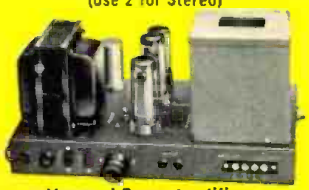
FM Tuner HFT90

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

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

Over 1 MILLION EICO instruments in use throughout the world.

NEW STEREOPHONIC EQUIPMENT

HF85: Stereo Dual Preamplifer is a complete stereo control system in "low silhouette" design adaptable to any type of installation. Selects, preamplifies, controls any stereo source—tape, discs, broadcasts. Superb variable crossover, feedback tone controls driven by feedback amplifier pairs in each channel. Distortion borders on unmeasurable even at high output levels. Separate lo-level input in each channel for mag. phono, tape head, mike. Separate hi-level inputs for AM & FM tuners & FM Multiplex. One each auxillary A & B input in each channel. Independent level, bass & treble controls in each channel may be operated together with built-in clutch. Switched-in loudness compensator. Function Selector permits hearing each stereo channel individually, and reversing them; also use of unit for stereo or monophonic play. Full-wave rectifier tube power supply. 5-12AX7/ECC83, 1-6X4. Works with any 2 high-quality power amplifiers such as EICO, HF14, HF22, HF30, HF35, HF50, HF60. Kit $39.95. Wired $64.95. Includes cover.

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. "Service Selector" switch permits one preamp-control section to drive the internal power amplifiers while other preamp-control section is left free to drive your existing external amplifier. Kit $69.95. Wired $109.95. Incl. cover.

MONAURAL PREAMPLIFIERS (stack 2 for Stereo)

NEW 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 Xfmr.; "One of the best-performing amplifiers extant; an excellent buy." AUDIOCRAFT Kit Report. Kit $72.95. Wired $99.95. 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 specs at 50W. Kit $57.95. Wired $87.95. Cover E-2 $4.50.

NEW HF35: 35-Watt Ultra-Linear Power Amplifier. Kit $47.95. Wired $72.95. Cover E-2 $4.50.

HF30: 30-Watt Power Amplifier. Kit $39.95. Wired $62.95. Cover E-3 $3.95.

NEW HF22: 22-Watt Power Amplifier. Kit $38.95. Wired $61.95. Cover E-2 $4.50.

NEW HF14: 14-Watt Power Amplifier. Kit $23.50. Wired $41.50. Cover E-6 $4.50.

MONAURAL INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF52: 50-Watt Integrated Amplifier with complete "front end" facilities & Chicago Standard Output Transformer. "Excellent value"—Hirsch-Houck Labs. Kit $69.95. Wired $109.95. Cover E-1 $4.50.

HF32: 30-Watt Integrated Amplifier. Kit $57.95. Wired $89.95. Both include cover.

HF20: 20-Watt Integrated Amplifier. "Well-engineered" — Stocklin, RADIO TV NEWS. Kit $49.95. Wired $79.95. Cover E-1 $4.50.

HF12: 12-Watt Integrated Amplifier. "Packs a wallop"—POP. 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". "Eminently musical; would suggest 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. "One of the best buys you can get in high fidelity kits." — AUDIOCRAFT KIT REPORT. Kit $39.95*. Wired $65.95*. Cover $3.95.

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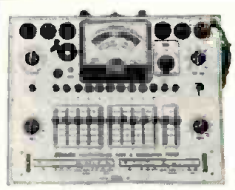

NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

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!

Series/Parallel R-C COMBINATION BOX #1140

KIT $13.95 WIRED $19.95

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- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter $4.50

6V & 12V BATTERY ELIMINATOR & CHARGER #1050

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Extra-filtered for transistor equipt. #1060 KIT $38.95 WIRED $47.95

New!

Miniaturized MULTI-SIGNAL TRACER #147A

KIT $19.95 WIRED $28.95

20,000 Ohms/Volt V-O-M #565

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1000 Ohms/Volt V-O-M #536

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Reads 0.5 ohms —500 megs, 10 mmfd—5000 mfd, power factor.

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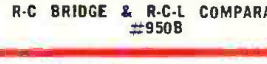
R-C BRIDGE & R-C-L COMPARATOR #950B



VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2		$4.95
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

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; 50-225 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.

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 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.

5" PUSH-PULL Oscilloscope #425: Kit $44.95, Wired $79.95.
7" PUSH-PULL Oscilloscope #470: Kit $79.95, Wired $129.50.

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%; 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. amplifier: only 3.0 v needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

KIT $29.95 WIRED $49.95

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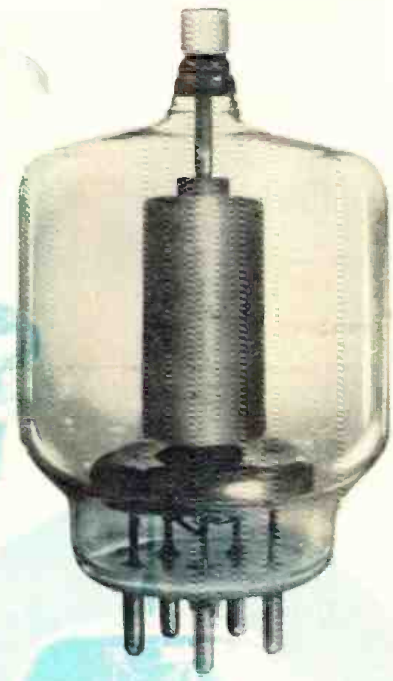


By **DAVID SASLAW**
Amperex Electronic Co.

INDUSTRIAL TUBES & THEIR USES

The growing industrial electronics field relies on special electron tubes designed to do special jobs.

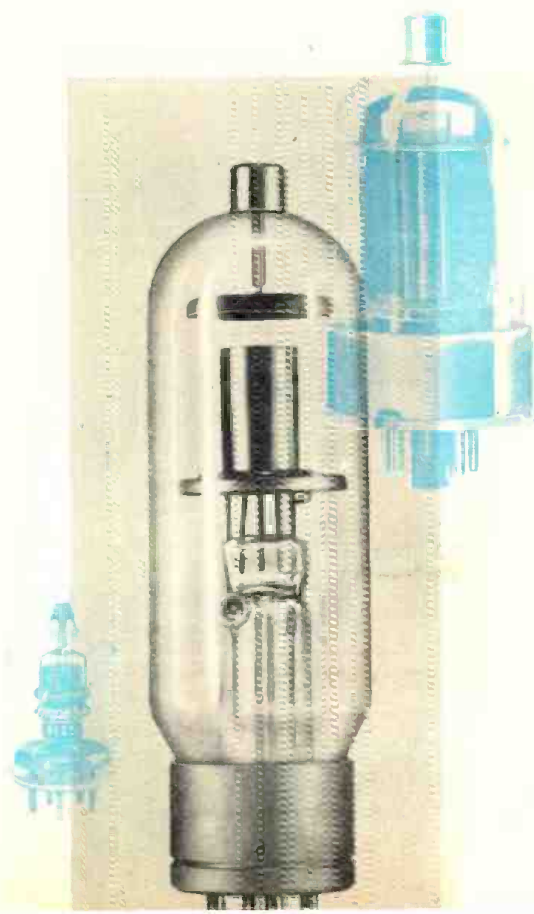
NOWADAYS the magic words in the electronics industry are "transistor" and "micro-miniaturization." Mere mention of these words induces visions of miniature components going into miniature equipment having miniature power requirements. However, this is only part of the picture; a more detailed examination of the industry reveals a strong upsurge in the use of large electron tubes which go into massive industrial equipment having correspondingly high power requirements.

At first glance it is hard to understand how these apparently contradictory trends could be part of the same picture. The connection becomes clear only when we realize that the large tubes are an essential part of the production machinery used to produce transistors. In truth the transistor could not have been developed to its present state if it had not been for the prior development of large industrial tubes.

For instance, one of the obstacles which faced the would-be transistor manufacturer was to produce, in quantity, germanium crystals pure to within a few parts in a billion. It was not until specialized induction heating equipment was developed that large scale crystal growing became a reality. In turn, the induction heating equipment could not be developed until suitable industrial tubes were available.

Let us not forget, however, that these advances in industrial electronics are relatively recent. Despite this the electronics industry has done a tremendous amount to further automation technology by developing tubes and circuits to control production machinery and also by developing tubes and circuits to increase the efficiency of the industrial processes. In fact, it is through processes such as induction and dielectric heating and ultrasonics that the extent of the upsurge in the use of large tubes can be measured. For example, in the case of the ultrasonics industry, commercial volume in 1957 exceeded about $25,000,000, up from practically nothing several years earlier. It is predicted that within a few years sales may top $100.000,000. As for induction and dielectric heating, the volume of industrial equipment sales has increased from about $185,-000.000 in 1954 to over $300,000,000 in 1957.

This rapid growth, in conjunction with its relative newness, makes the field of electronics of special interest to the technician. Although most of the present equipment is serviced by the manufacturer, the trend is away from this type of arrangement and towards servicing by individual companies within the neighboring area. This is one place where the independent TV and radio technician, if he is alert, could find additional business income. To succeed he must understand the general scope of the field, the types of tubes and where they are used, and



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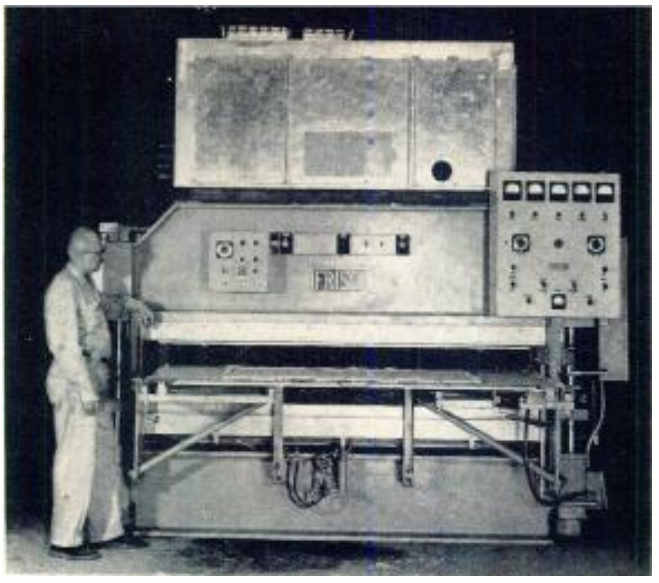
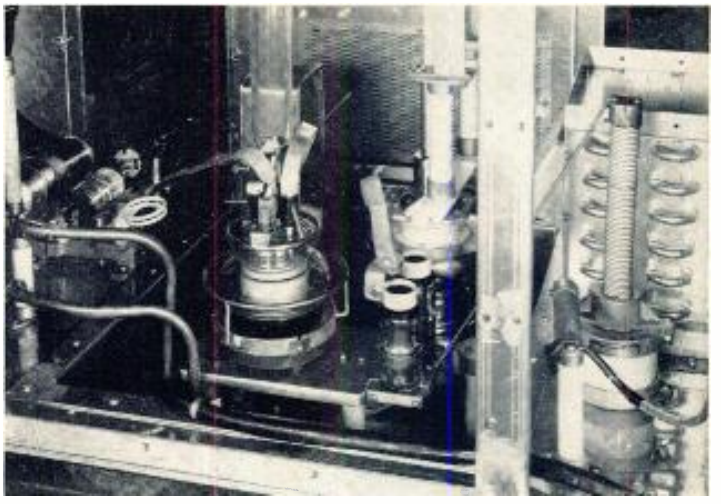


Laminating press ready to bond inside panel of automobile door.



Oscillator for large dielectric-heating plastic laminating press.

be able to identify the different types of equipment.

What Is an Industrial Tube?

Before going into the specific uses of high-frequency energy, we should get some idea of what an industrial tube is. After all, the tube is really the heart of industrial high-frequency equipment. In reality there are two operating conditions which clearly separate the industrial tube from other similarly rated tubes. These are: 1. The industrial tube works into loads which vary widely in impedance. 2. The industrial environment includes constant vibration plus large intermittent shocks.

In the early development stages of high-frequency equipment, communications tubes were used because they were immediately available and nominally satisfied the frequency and power requirements. However, it soon became obvious that many of these tubes wouldn't hold up in industrial service. The first approach to solving the problem involved decreasing the length of the tube elements to improve mechanical strength. This still didn't do it. The problem wasn't fully solved until the tubes were designed to withstand overloads on the anode and grid caused by the varying load impedances. It was at this point that industrial tubes became really different from communications tubes. Massive graphite anodes were incorporated in the radiation-cooled tubes and very heavy copper anodes in water—or forced-air-cooled tubes. Naturally the grids were made proportionately heavier too. The result is that for an equivalent power and frequency rating, the industrial tube is larger and more rugged than the communications tube. Table 1 lists some r.f. oscillator triodes and mercury vapor rectifiers used in various industrial applications.

Of all the applications of industrial electronics, induction and dielectric heating, and ultrasonics represent the greatest potential to the technician—they are new enough for him to get in on the "ground floor." In addition, circumstance is working in his favor since all three fields use similar high-frequency generators to power their working elements. By becoming familiar with the type of generator used in one field, a good insight is gained about the generators used in the other two.

Electronic generators are built with outputs ranging from a fraction of a kilowatt to several hundred kilowatts. However, no matter what the power output, the generator always contains both a rectifier and an oscillator section. Mercury vapor tubes are usually used in the rectifier section to provide the high-voltage d.c. used by the oscillator. The oscillator tube, in a suitable circuit, produces the required high-frequency energy.

Most industrial oscillator circuits are adaptations of the Colpitts and Hartley

Table 1. R.f. oscillator and mercury vapor rectifier tubes are listed here along with some of their applications.

TUBE TYPE	PLATE POWER OUTPUT (watts)	FREQUENCY* (mcs)	APPLICATION			
			Induction Heating	Dielectric Heating	Ultrasonics	Power Rectifier
833A	1600	30	X			
866AX	—	—				X
872A	—	—				X
5771	40000	25	X	X		
5868/AX9902	1690	100	X	X	X	
6146	70	60			X	
6155/4-125A	375	120			X	
6156/4-250A	1000	75			X	
6693	—	—				X
6800	33000	22.5	X	X		
6961	6000	50	X	X		
7092	2720	50	X		X	
7237	6000	50	X	X		

*Higher frequency operation possible at reduced power output.

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circuits shown in Fig. 2. These circuits are essentially class C amplifiers in which part of the output power is fed back to the input to create the drive. The output power is coupled to the load by either inductive or capacitive action. The inductive coupling is achieved by making the work coil part of the output tank circuit. Capacitive coupling is accomplished by using a portion of the voltage across the tank circuit to develop an electrostatic field in the load.

In general, industrial oscillator circuits are extremely simple to service although the high energy used does create special problems. The main difficulty for the technician will be his lack of familiarity with the effects of varying load impedances. This is of special significance because the variations are very large; as much as 50% from the beginning of an operating cycle to the end.

Induction Heating

As early as 1900, attempts were made to heat metals by inducing currents in them through the medium of a magnetic field. Many of these attempts were successful, but because of technical difficulties, the process remained essentially a laboratory phenomenon. In the period from 1930-1940, advances in radio engineering laid the groundwork which made it possible for induction heating to come out of the laboratory. The high-frequency, high-energy radio tubes developed during this period were not actually successful for industrial applications, but the differences involved ruggedness rather than basic design. It didn't take long for the tube designers to make the required changes and for industry to find still more applications for the new tubes.

Before going into the applications, we should get some idea of how induction heating works. The process basically consists of inducing current in the work piece by placing it in a varying magnetic field. The induced current acts the same as any other current to produce heat as a simple I^2R function. In non-magnetic materials eddy current losses do the heating while in magnetic materials it is a combination of eddy current and magnetic hysteresis losses. Both these quantities are affected by frequency, but hysteresis losses vary directly with frequency while eddy losses increase as the square of frequency. Since induction heating generators usually operate at fairly high frequencies, the hysteresis losses become insignificant in relation to the eddy current losses. Also, because eddy current losses increase as the square of frequency, it might be assumed that the heating action would increase by the same ratio. Unfortunately, this is only true at the lower frequencies. Table 2 indicates the power and frequency range usually used in induction and dielectric heating and ultrasonics.

An additional effect of frequency is that the depth of current penetration

COVER STORY

AUTOMATION, and the role played by the electronics industry in achieving it, has been in the news so much of recent years that another story about it hardly creates much interest. On the other hand, a story about the continuing need for hand craftsmanship by an electron tube manufacturer, presumably a prime mover in the trend towards automation, is both interesting and newsworthy. The cover picture illustrates just such a situation at the plant of Amperex Electronics Co., Hicksville, Long Island.

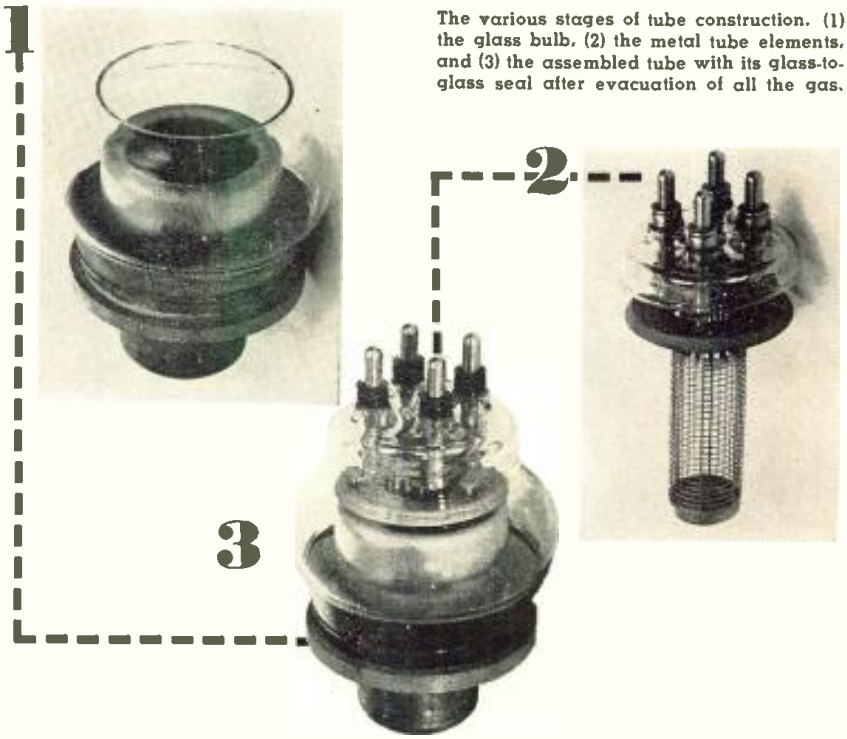
The intricately contoured glass bulbs of many large electron tubes are still shaped by essentially the same methods used in the early days of tube production; that is, by means of hand-held tools manipulated by a skilled operator. The cover photo shows a craftsman shaping the bulb of a modern industrial triode, Amperex Type 5771, using only the paddle in his left hand. He presses the paddle against the flame-softened glass, slowly changing the contours until the desired shape is reached. Working as fast as the process will allow, it takes him fully 20 minutes to shape each 5771. Rotating at the same speed as the envelope are the tube's elements at the right. Our photographer's photoflash and fast shutter speed "froze" the rotation.

Examination of the finished tube leaves no doubt that a great deal of skill is required to produce its complex shape with precision and speed. But skill is not enough; there are so many differently shaped tubes made today that wide experience is also necessary. For example, Tom Fagan, the operator shown in the cover photo, has been shaping glass at Amperex for more than 20 years. In addition, his crew (Tom is the foreman) averages 10 years' experience per man. This heavy concentration of experience is no accident however, it clearly indicates the high calibre of craftsman needed for this job.

Turning the process back a few steps, we discover that the bulb started out as an ordinary cylinder of glass. In order to shape the glass it must be heated until it is plastic; soft enough to model with a paddle and yet firm enough to retain its imparted shape. The glass is a special composition (Corning Type 705) designed to facilitate metal-to-glass seals.

After being shaped, the bulb is joined to the mount assembly by a glass-to-glass seal, the operator again exercising his skill to make the joint "electrically invisible" (at radio frequencies heated glass becomes a conductor thus raising the possibility of bulb failure in areas of varying thickness due to localized heating). The next step is to evacuate all gas from the tube. A multiple-stage vacuum pump removes gas from the bulb while an induction heater frees any gas trapped in the metal tube elements. When the vacuum reaches 10^{-7} mm. of mercury, the tube is sealed. Finally the completed tube is tested and inspected thoroughly to insure high quality. The completed tube is a high-power triode and is used as an r.f. oscillator in induction and dielectric heating equipment and in radio transmitters. It operates in the frequency range from 2-25 mc. at a plate power output of 40 kilowatts. It sells for $600.00.

(Cover photo by Dave Henderson)



The various stages of tube construction. (1) the glass bulb, (2) the metal tube elements, and (3) the assembled tube with its glass-to-glass seal after evacuation of all the gas.

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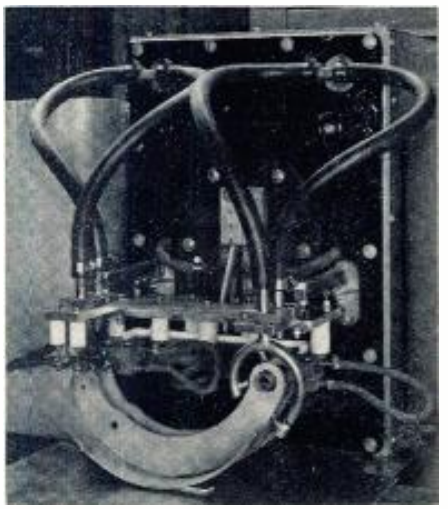


Automotive brake shoes being induction welded in unit shown directly above.

Fully assembled parking meter is being cleaned in the ultrasonic bath at the left.

decreases as the frequency increases. Another way of looking at this is that the heating can be confined to the surface by choosing the appropriate frequency.

Now let us examine the applications. These can be divided into three categories; processing, joining, and melting of metals. (Non-metals can be heated too, but the amount actually processed this way is so small that it can be ignored.) Metal processing includes surface hardening, annealing, drawing and normalizing; metal joining includes welding, brazing, and soldering; and metal melting includes growing extremely pure crystals (like the germanium crystals mentioned before) and refining the special ores required.

By examining these applications we can draw some conclusions about the type of generator needed for each category. In metal processing only the surface is heated. This requires relatively high frequencies, the exact frequency depending upon the penetration required. See Fig. 1. On the other hand, the amount of power required depends on both the depth of penetration and the material. For instance to case harden steel shafts 1⅛ inch in diameter, to a depth of 0.030 inch requires a 25 kilowatt generator.

The power required for metal joining is roughly the same as for processing (see Table 3), but the operating frequency may be higher. For instance, frequencies up to 3 megacycles are used to seam-weld copper tubing. The power needed for metal melting varies widely from much greater than to about the same as the other areas. The much greater power is explained by the large mass of metal normally melted in an induction furnace. However, a recent application such as the zone refining (crystal growing) of silicon for transistors requires only a 10 kilowatt generator operating at 4 megacycles.

In general, then, it can be said that most induction heating generators operate in the frequency range from 10 to 500 kilocycles with some new applications going up to 4 megacycles. Also the most commonly used size is 25 kilowatts, although there are applications which require up to 1200 kilowatts.

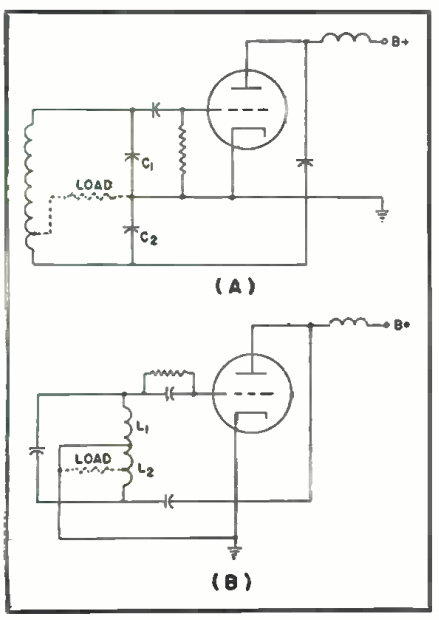
Dielectric Heating

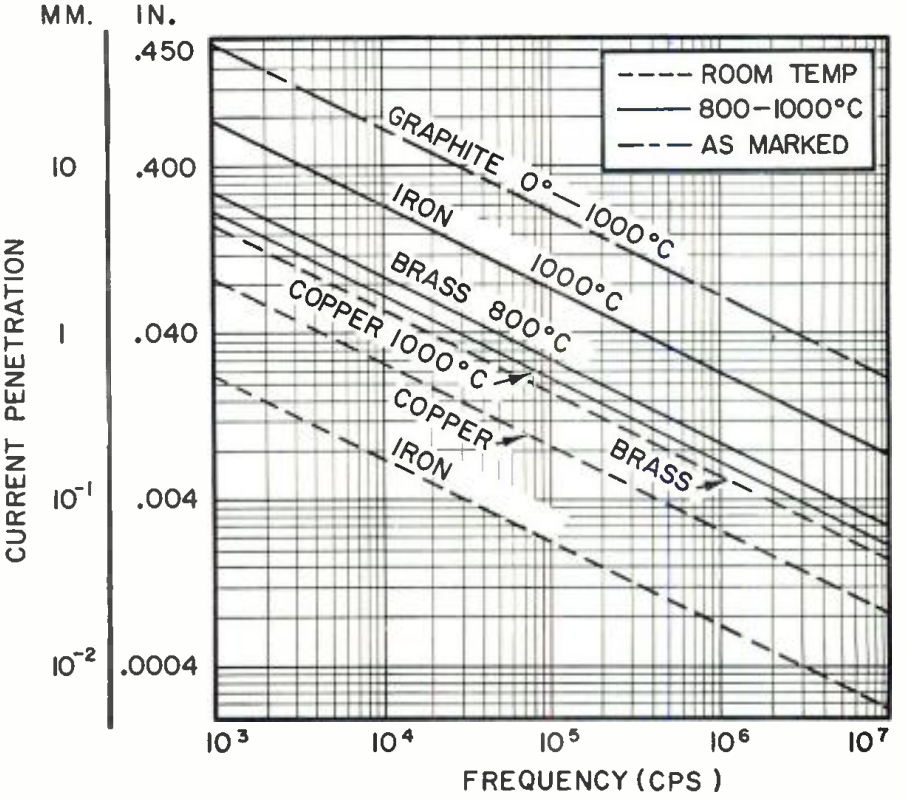
Dielectric heating, like induction heating, is also a by-product of the

(*Continued on page* 98)

Fig. 1. Current penetration for common → materials at various applied frequencies.

↓ Fig. 2. Basic Colpitts (A) and Hartley (B) oscillator circuits. Refer to text.





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A Compact, Low-Ripple Radio Battery Eliminator

Simple power supply replaces "A" and "B" batteries without introducing hum.

Fig. 1. The portable connected to its a.c.-powered pack.

By **WILLIAM V. LOEBENSTEIN**

AS LONG as there are battery-operated radios there will always be a certain species of individual who will not rest until he has successfully eliminated the batteries. The reason the job isn't easy is because of the high degree of filtering that must be attained in order to eliminate hum caused by line frequency. Doing away with the "B" battery is relatively easy. The current drain is small and normal *RC* filtering is adequate with a conventional power supply. The real problem arises in trying to eliminate the "A" battery because the current is relatively high and the filaments through which it flows serve also as the cathodes, which are extremely sensitive to hum. A filter of the conventional *LC* or *RC* design, with sufficiently low ripple voltage to be acceptable, would be prohibitively expensive and quite bulky, to say the least. An extremely versatile network and one which is all too often overlooked is the parallel-T filter. It fits the bill perfectly in this application.

Electrifying the battery radio could have been accomplished by rewiring the tube sockets and replacing the tubes with others of similar characteristics but with indirectly heated cathodes. One excellent example which the author has seen described utilizes a very satisfactory arrangement in that there is no need for a separate a.c.-operated power-supply chassis. In the present instance an auxiliary chassis is required for the composite power supply, as shown in Fig. 1. A distinct advantage, however, is the fact that the radio itself has not been modified in any way. In other words, while its versatility has been increased through complete electrification, the power pack can be disconnected and the batteries re-installed in less than two minutes!

The set for which the power supply was designed is an *RCA* Model BP-10 "Personal Radio" powered by one 67½ volt *Minimax* "B" battery and one 1½ volt flashlight-type "A" battery. Its tube complement consists of a 1R5, a 1T4, a 1S5, and a 1S4. By placing a milliammeter in series with each battery, in turn, the current requirement was found to be 9 to 10 ma. for the "B" battery and about ¼ ampere for the "A" battery. (These quantities could have been estimated from the average characteristics of the tubes. This is less reliable than the actual measurement, however, as any experimenter will agree.) Ohm's Law can now be used to replace the radio by two dummy loads until the power supply has been constructed. The example for the case at hand is: 67.5 / 0.0095 = 7000 ohms dummy load for the "B" supply and 1.5 / 0.25 = 6.0 ohms for the "A" load.

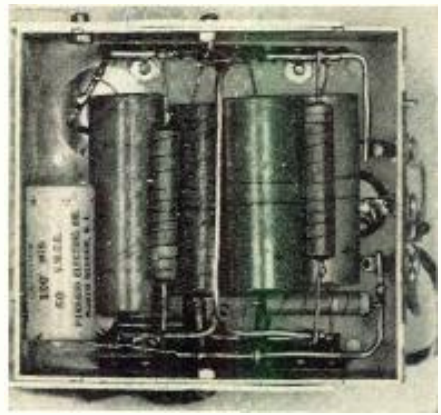
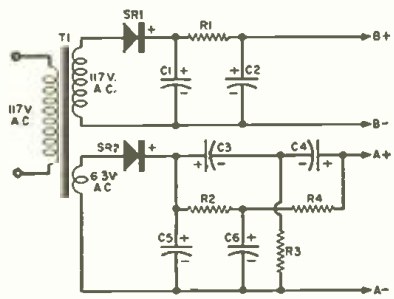


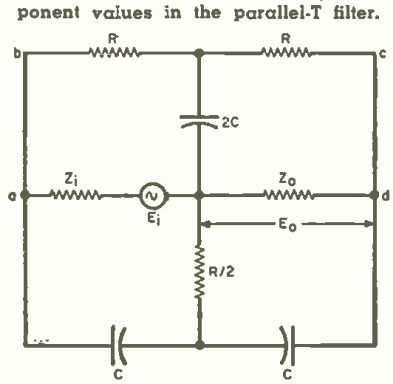
Fig. 2. Bottom view of power supply.



R₁—9000 ohms, 10 w. wirewound res.
R₂, R₄—4½ ohm, 10 w. wirewound res. (see text)
R₃—2¼ ohm. 10 w. wirewound res. (see text)
C₁-C₂—40/40 μfd., 150 v. elec. capacitor
C₃, C₄—500 μfd., 15 v. elec. capacitor
C₅—100 μfd., 50 v. elec. capacitor
C₆—1000 μfd., 15 v. elec. capacitor
T₁—Power trans. 117 v. @ 30 ma.; 6.3 v. @ .6 amp.
SR₁—65 ma. selenium rectifier
SR₂—250 ma. selenium rectifier (modified, see text)

Fig. 3. Schematic of the eliminator.

Fig. 4. Dicgram for determining component values in the parallel-T filter.



Construction of "B" Supply

The "B" supply is shown mounted on the top deck of the chassis in Fig. 1. It is a conventional half-wave rectifier consisting of an isolating transformer, selenium diode. and a single pi-section *RC* filter. The final step in completing the "B" supply is the choice of a suitable dropping resistor to place in the filter circuit. Again Ohm's Law came to the rescue. The capacitor-input filter would charge to peak if it weren't for the internal impedance of the rectifier. Peak voltage is equal to the transformer high-voltage secondary multiplied by $\sqrt{2}$ or about 165 volts. The internal impedance of the 65 ma. selenium rectifier is about 500 ohms (assumed to be all resistive). The total resistance of the circuit is equal to the sum of the load resistance, the internal impedance, and the unknown filter resistance *R*. Remembering that the current is about 10 ma., we have:

$$7000 + 500 + R = 165 / 0.01$$

or:

$$R = 9000 \text{ ohms}$$

Therefore, a resistance of this value was used and found to be about right.

Parallel-T Filter

Before continuing with the "A" supply, it would be well to consider the basic circuit of the parallel-T filter. A comprehensive solution for the general

(*Continued on page* 148)

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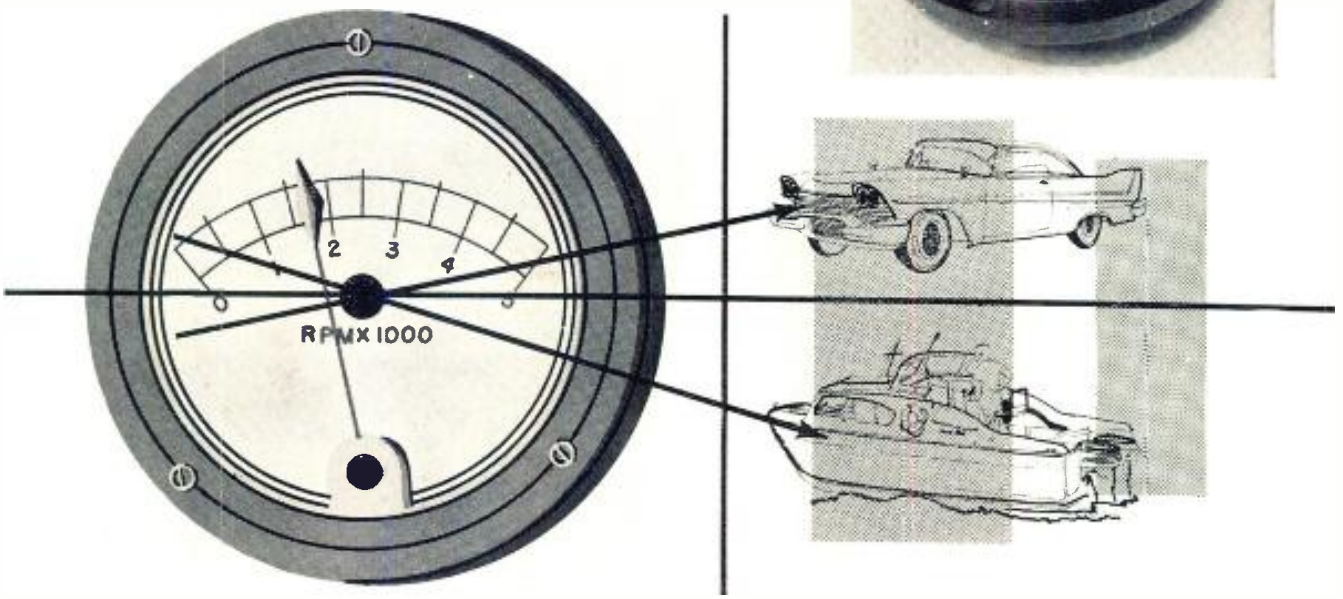
A TRANSISTORIZED TACHOMETER

By **RICHARD H. SMALL**
and
M. MICHAEL BRADY

A simple, electronic engine speed indicator, powered by 6- or 12-volt battery, for car driver or boat owner.

All components are mounted on a phenolic board disc fastened to meter terminals.

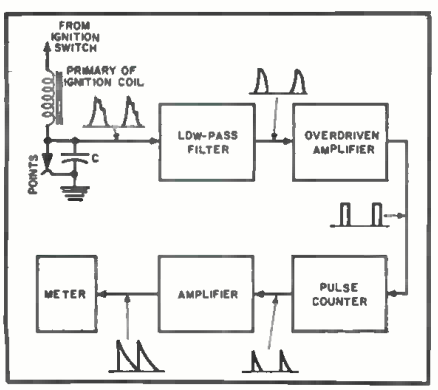


MANY car drivers or boat owners have a need to measure the speed of their engines and many, out of curiosity, find tachometers interesting. Almost all sports cars and a good many power boats are equipped with tachometers which read engine speed in rpm.

Automotive tachometers are usually identical to an ordinary speedometer in construction, except that they obtain their mechanical drive from the engine instead of a portion of the transmission geared directly to the drive shaft. Marine tachometers, on the other hand, are often of the generator-indicator type, because the distance between the engine and the instrument panel is usually too great to use a mechanical drive shaft. Both the speedometer-type and the generator-indicator type tachometers require a mechanical drive from the engine. To add such a mechanical drive to an engine is often a cumbersome task requiring at least an extra pulley on the fan belt or an attachment to the distributor.

Another approach to indicating engine speed is to measure the frequency of voltage pulses from the ignition system. Tube circuitry could be used to build such a pulse-frequency measuring device, but the problem of providing filament and plate potentials to tubes almost offsets the advantage of not having a mechanical drive. Transistors, however, can function at low supply voltages and are thus logical devices to use in an electronic tachometer circuit.

Fig. 1. Basic block diagram and waveforms of the transistorized tachometer.



The Basic Circuit

The basic block diagram of an electronic tachometer is shown in Fig. 1. The input to the circuit is in the form of low-voltage pulses from the primary side of the ignition coil. In a four-stroke cycle engine, each spark plug fires once every two revolutions of the crankshaft. If the engine has six cylinders, there is a total of three plug firings per revolution; if the engine has eight cylinders, there is a total of four plug firings per revolution. Each plug firing is produced by the opening of the breaker points in the primary circuit of the ignition coil. The direct relation between pulses-per-second from the primary of the ignition coil and engine rpm is: $f = CN/120$ where f is the pulse frequency, C is the number of cylinders, and N is the speed of the engine in rpm. For a two-stroke-cycle engine, each plug fires once every revolution of the engine, so this relationship becomes $f = CN/60$. The input to the tachometer circuit can then be regarded as pulses of frequency f.

Because the low-voltage pulses from the breaker points are not perfectly square and may contain a good deal of noise and extraneous signal due to point contact bounce, a low-pass filter is needed at input to the tachometer to remove signals above the highest frequency expected. The pulses from the output of the filter are then amplified and clipped in an overdriven voltage amplifier and fed to a pulse counter circuit. The output of the pulse counter is a pulse train of total volt-time area

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directly proportional to the pulse frequency of its input. The output of the counter is then amplified and fed to some integrating indicator device.

Circuit and Its Operation

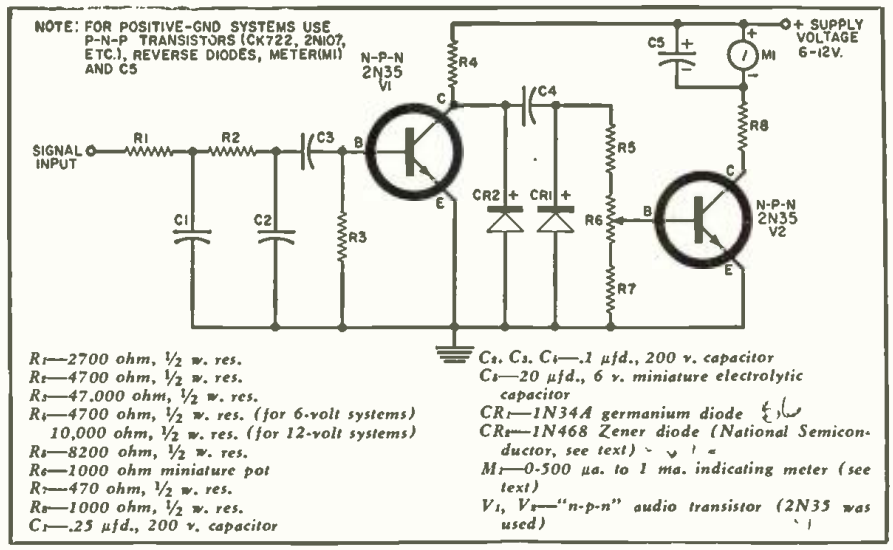
The schematic diagram of the transistorized tachometer for negative-ground electrical systems is shown in Fig. 2. This circuit is designed for operation on six or twelve volts, as indicated on the schematic. The circuit functions in exactly the same fashion as does the general block-diagram circuit of Fig. 1. The input low-pass filter is formed by resistors R_1 and R_2 and capacitors C_1 and C_2. The values of these components are chosen so that the filter attenuates above 350 cycles, which corresponds to an eight-cylinder engine speed of 5250 rpm. If a maximum tachometer indication of greater than 5000 rpm is desired, then appropriate values should be chosen to provide a higher filter cut-off frequency. Capacitor C_3 couples the output of the filter to the common-emitter-connected clipper-amplifier transistor, V_1, while resistor R_3 provides the necessary input bias resistance. R_4 is the load resistance for the first stage.

Capacitor C_4, diode CR_1, and resistors R_5, R_6, and R_7 form the "pulse counter" circuit. The function of the counter is to convert constant-amplitude square pulses into constant volt-time area exponential-fall pulses. The effective counter circuit is shown in Fig. 3. The transistor driver-clipper, V_1, is represented by an equivalent square-pulse generator in series with an internal resistance R_i, the diode CR_1 being represented by a switch. With each rising edge of an input square pulse, the diode CR_1 conducts and capacitor C_4 charges almost to the peak value of the input pulse in a time determined by the relatively short time-constant R_i-C_4. When the input drops to zero with the fall of an input pulse, the diode CR_1 blocks and capacitor C_4 discharges through the output resistance R_o (R_5-R_6-R_7 in Fig. 2), with a rate of fall determined by the time constant R_o-C_4. In this manner the output of the circuit is an exponential fall pulse for each square pulse in.

The second transistor V_2, serves as a current amplifier to amplify the input pulses which are then integrated by the meter M_1. Capacitor C_5 aids the integrating properties of the meter at low pulse frequencies.

Meter M_1 can be any standard 500 microampere to 1 milliampere meter. The meter used in the unit shown in the photo was removed from war-surplus aircraft electronic equipment. Because the meter must be re-calibrated in rpm, almost any meter scale is acceptable. A convenient scale conversion would be to use a 0-500 microampere meter scale for a 0-5000 rpm tachometer.

The component parts used in the circuit are standard miniature transistor-circuit components. All resistors are ordinary ½-watt carbon units, while the potentiometer, R_6, is a miniature unit. Capacitors C_1, C_2, C_3, and C_4 are miniature 200-volt units intended for printed-circuit transistor work. C_5 is a miniature electrolytic with a 6 working volt rating. Transistors V_1 and V_2 are ordinary *n-p-n* audio-frequency transistors. The operation of the circuit is such that the over-all parameters of transistors are not of prime importance: almost any inexpensive transistor will perform the function well. The counter diode CR_1 is an ordinary germanium diode. The entire circuit can be mounted on a phenolic board and fastened to the meter terminals, as shown in the photo.



R_1—2700 ohm, ½ w. res.
R_2—4700 ohm, ½ w. res.
R_3—47,000 ohm, ½ w. res.
R_4—4700 ohm, ½ w. res. (for 6-volt systems) 10,000 ohm, ½ w. res. (for 12-volt systems)
R_5—8200 ohm, ½ w. res.
R_6—1000 ohm miniature pot
R_7—470 ohm, ½ w. res.
R_8—1000 ohm, ½ w. res.
C_1—.25 μfd., 200 v. capacitor
C_2, C_3, C_4—.1 μfd., 200 v. capacitor
C_5—20 μfd., 6 v. miniature electrolytic capacitor
CR_1—1N34A germanium diode
CR_2—1N468 Zener diode (National Semiconductor, see text)
M_1—0-500 μa. to 1 ma. indicating meter (see text)
V_1, V_2—"n-p-n" audio transistor (2N35 was used)

Fig. 2. Complete diagram for negative-ground system. See note for positive ground.

Calibration and Operation

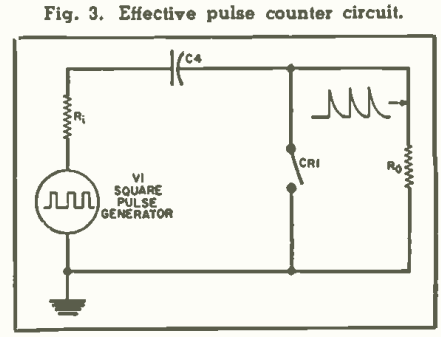
The unit may be calibrated so that the meter reads full-scale for any desired input frequency. As an example, a six-cylinder engine full-scale deflection of 500 microamperes could be set to correspond to an input pulse frequency of 250 pulses-per-second, or an engine speed of 5000 rpm. The unit should, of course, be calibrated using a pulse generator with a known pulse frequency output. However, a very accurate calibration can be obtained using an ordinary sine-wave audio oscillator to supply the input signal. The output amplitude of the oscillator should be set in such a way that further increases in amplitude do not affect the reading of meter M_1. The circuit is then operating on the positive peaks of alternate half-cycles of the oscillator output.

The potentiometer, R_6, should be adjusted to give full-scale deflection of the meter for the computed maximum frequency corresponding to the desired full-scale rpm reading. Two or three other points should then be checked to determine if the meter reads linearly with input frequency.

The basic circuit of Fig. 2 may be modified in many ways to improve performance and increase the accuracy of the rpm indication. The regulation of the electrical-system voltage in most cars and boats is fairly good except when the engine is idling and the battery is discharging heavily. The pulse counter of the tachometer circuit is partially sensitive to changes in input voltage. If the quiescent output voltage of transistor V_1 is not constant, then the tachometer will be in error by an amount proportional to the percentage variation from the normal quiescent voltage at which the unit was calibrated. The input voltage to the counter can be held constant by using a regulator diode (CR_2 in Fig. 2). The diode in the unit shown is a silicon Zener diode (diode operated at its breakdown voltage in the reverse direction) with a Zener voltage of about 4.5 volts. Many semiconductor manufacturers make Zener diodes; the one in the authors' unit is a *National Semiconductor* 1N468.

In operation the entire unit draws less than 2 milliamperes from its power source and, in addition, requires no mechanical connections to the engine. The electrical connections are simple: one ground, one power lead from the ignition switch, and one signal lead from the distributor breaker points. The wide variety of meters and components available makes the unit readily adaptable to almost any dashboard or instrument panel layout. The authors have mounted their units in the space provided in the dashboard for the installation of a clock. The cost of the unit is relatively small compared to shaft-drive or generator-indicator types of tachometers. It should have a life expectancy limited only by the life of the transistors used. -30-

Fig. 3. Effective pulse counter circuit.



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Low-Cost Stereo System

By R. J. MEAGHER
Senior Engineer, CBS-Hytron

For less than $100, including speakers, you can enjoy stereo using this home-built dual 10-watt amplifier.

STEREOPHONIC sound can now be enjoyed without lavish outlays for equipment, as this article will prove. The stereophonic sound system to be described can easily be built by anyone who has ever made a radio or audio amplifier.

The audiophile who considers any speaker costing less than $100 inferior may not appreciate this system since the amplifier and speakers together in this setup cost less than this sum.

The author had been enjoying long-playing records using an old changer and a good fidelity amplifier unit. Then the new stereo records became available and the problem of how to take advantage of this sound "bonus" without spending a small fortune cropped up. After looking at various units and reading many articles on the subject, the author designed this particular system with two thoughts in mind. The first criterion was good stereo sound rather than a system having fancy specifications and the second was to keep costs at a minimum by using parts on hand where possible. Both objectives were met.

The Pickup

The stereo cartridge selected by the author was the *Columbia* CD compatible stereo cartridge, Model SC-1. It was installed in the tone arm of the old changer with a second shielded cable (supplied with the cartridge) added for stereo. The arm was first balanced to have zero weight since the cartridge weight provides the proper tracking pressure. This was done by adjusting the spring load, but may be accomplished with lead weights on the rear of the arm. A pressure gauge can be used to verify the recommended stylus pressure of 5 to 7 grams.

The Amplifiers

The dual-amplifier was then built using the circuit of Fig. 3. One power supply feeds both amplifiers, and uses an old TV power transformer. Such a transformer is easily obtained and pro-

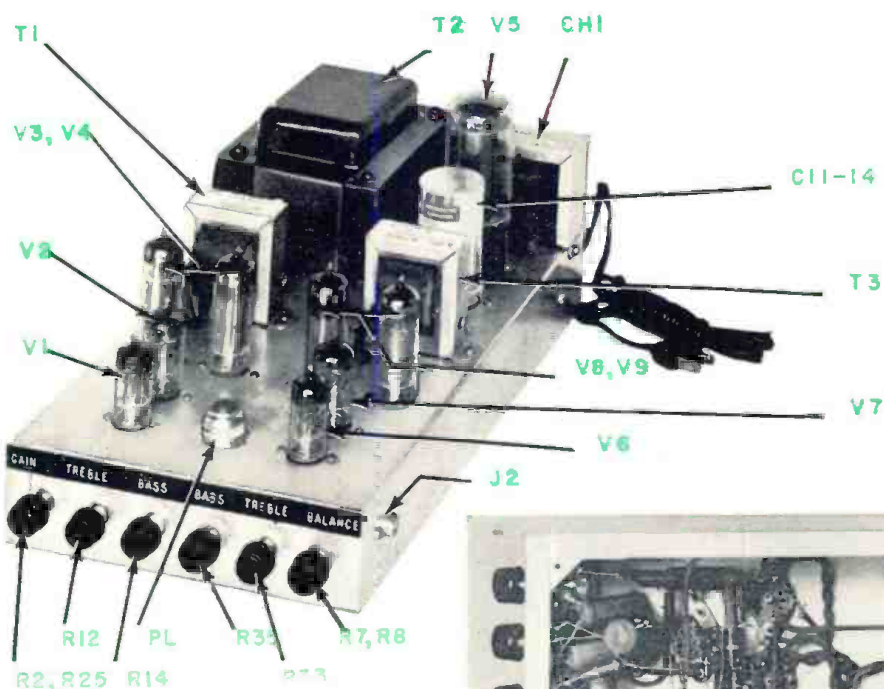

Fig. 1. An over-all view of the dual amplifier is shown in this illustration. Common power supply circuits for both channels of amplification are located at the very back portion of the chassis.

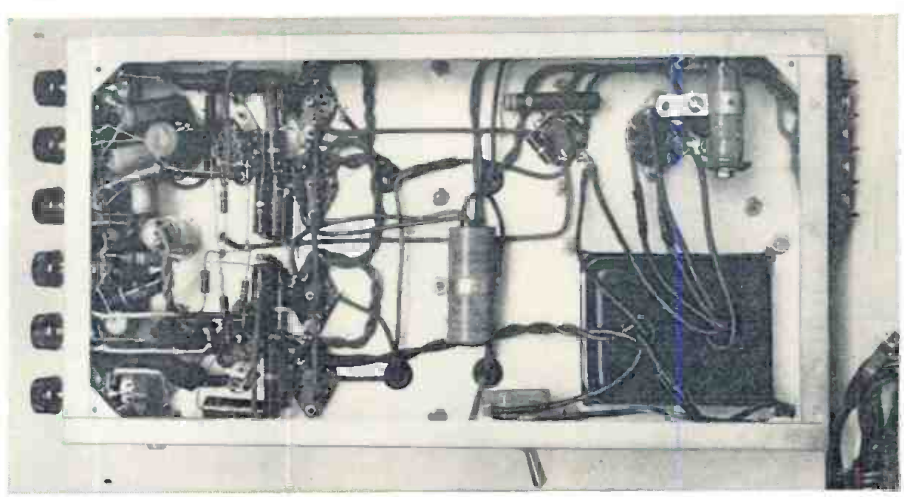

Fig. 2. Under-chassis view of the amplifier is shown here. Input terminals are on both sides of the chassis near the front, while the output terminals are on the rear panel just behind the tapped voltage-adjusting resistor R_{33}.

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vides high current with good regulation. The amplifiers are identical. The 7025 (the low-noise version of the 12AX7) was chosen for its low inherent noise and hum level and the 6BQ5 for its high gain. The first stages (6C4's) are included to take care of possible low-level inputs, but since a high-output cartridge was used (the *Columbia* SC-1 is rated at 0.4 volt) sufficient gain is derived in the 7025 stage to drive the 6BQ5's. Thus, with this type of cartridge, a further cost saving can be effected by eliminating the 6C4 stage of each amplifier. No shielding was found necessary due to the short leads from the two-channel, separated layout as shown in Fig. 2. A hum balancing potentiometer was not needed because of the fortuitous choice of tubes and layout. The heater leads to the tubes should be twisted all the way and the heater ground should be made at the 6C4 end. If hum level should prove objectionable, an aluminum mesh cover can be used on the bottom of the chassis. Oscillation or motorboating may occur in either amplifier and, if so, the blue and brown leads of the output transformer involved should be reversed.

All resistors and capacitors should be chosen for small physical size since space is at a premium in the front end. All potentiometers are small ½-watt units. Considerable saving was effected by using *Merit* #2904 output transformers. They are rated at 18 watts and exhibit very satisfactory response in this circuit (run within 10-watt rating).

The purpose of the 200-ohm, 20-watt resistor between the 5U4GB and filter choke is to adjust plate voltage to within 6BQ5 ratings. They operate at about 300 volts. This will vary with different power transformers so that, in some cases, a larger resistor may be needed. R_1, R_{24}, R_2, R_{25} and C_1, C_{15} provide equalization for the SC-1 cartridge. If a different cartridge is used, these values should be changed to conform to the manufacturer's suggestions.

The positions of the line switch, input jacks, and pilot light (the latter is not shown in the schematic) were chosen only for convenience in the author's built-in cabinet and may be relocated for each individual case, taking care to keep the leads from the jacks to the tubes short and the 117-volt a.c. leads away from the high-gain inputs.

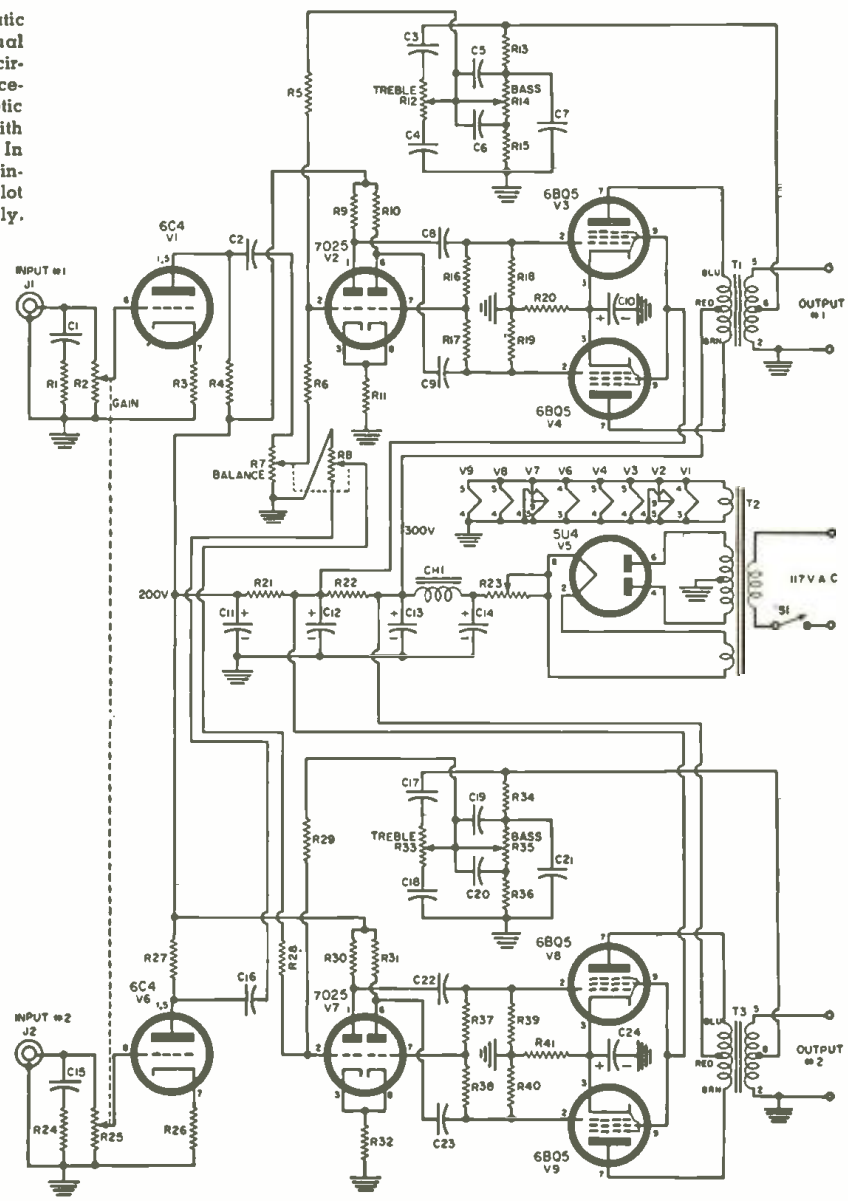
Little further need be said about the amplifier circuits, since they are straightforward. Figs. 1 and 2 show the parts layout. Except for keeping leads short to avoid the necessity for shielding, the parts layout is not critical. Be sure to place the power transformer so that its windings are at right angles to the output transformers to prevent induced 60-cycle hum, since they are close to one another.

The Controls

Referring to the circuit diagram (Fig. 3) and the front-view photograph (Fig. 1), there is a single master gain control for both channels. This control is R_2, R_{25}, a dual potentiometer, shown

(*Continued on page* 104)

Fig. 3. Here is the complete schematic diagram and parts listing for the dual 10-watt stereo power amplifier. The circuit is designed to accommodate a ceramic stereo cartridge. If a magnetic cartridge is to be used, a preamp with proper equalization would be needed. In this case the RC networks across the input jacks must be removed. A 6-volt pilot lamp may be wired across heater supply.



R_1, R_{24}—180,000 ohm, ½ w. res.
R_2, R_{25}—1 megohm, ½ w. dual linear-taper pot
R_3, R_{26}—1500 ohm, ½ w. res.
R_4, R_{27}—150,000 ohm, ½ w. res.
R_5, R_{29}—1 megohm, ½ w. res.
R_6, R_{28}—470,000 ohm, 1 w. res.
R_7, R_9—500,000 ohm, ½ w. dual linear-taper pot
R_9, R_{10}, R_{30}, R_{31}—270,000 ohm, ½ w. res.
R_{11}, R_{32}—1000 ohm, 1 w. res.
R_{12}, R_{14}, R_{33}, R_{35}—50,000 ohm, ½ w. linear-taper pot
R_{13}, R_{34}—10,000 ohm, ½ w. res.
R_{15}, R_{36}—680 ohm, ½ w. res.
R_{16}, R_{17}, R_{18}, R_{19}, R_{37}, R_{38}, R_{39}, R_{40}—1 megohm, ½ w. res.
R_{20}, R_{41}—150 ohm, 2 w. res.
R_{21}—1000 ohm, 2 w. res.
R_{22}—4700 ohm, 2 w. res.
R_{23}—200 ohm, 20 w. adj. res.
C_1, C_{15}—.002 µfd., 600 v. disc ceramic capacitor
C_2, C_3, C_{16}, C_{17}—.01 µfd., 600 v. disc ceramic capacitor
C_4, C_{18}—.05 µfd., 600 v. disc ceramic capacitor
C_5, C_6, C_9, C_{19}, C_{22}, C_{23}—.02 µfd., 600 v. disc ceramic capacitor
C_8, C_{20}—.2 µfd., 200 v. capacitor
C_7, C_{21}—.0003 µfd., 600 v. disc ceramic capacitor
C_{10}, C_{24}—20 µfd., 50 v. elec. capacitor
C_{11}-C_{12}-C_{13}-C_{14}—20/20/10/10 µfd., 450 v. elec. capacitor
S_1—S.p.s.t. switch
J_1, J_2—RCA-type phono jack
CH_1—2 hy., 200 ma. filter choke (Author used old TV choke. Merit C2974 or equiv.)
T_1, T_2—Universal output trans. 4000/7000/8000/10,000/14,000 ohms c.t. to .17 to 32 sec. (Merit A-2904 or equiv.)
T_3—Power trans. 350-0-350 v. @ 200 ma.; 5.0 v. @ 3 amps; 6.3 v. @ 4 amps (Triad R-20-B or old TV transformer can be used)
V_1, V_6—6C4 tube
V_2, V_7—7025 tube
V_3, V_4, V_8, V_9—6BQ5 tube
V_5—5U4GB tube
Spkrs—6" x 9" ovals (Author used Lafayette SK75)

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Airborne Relay for Intercontinental TV

The French Air Force radar-testing "Bretagne" bomber was specially outfitted as an intercontinental TV relay station.

By **A. V. J. MARTIN**
Carnegie Institute of Technology

Successful French attempt links North Africa to Europe by means of single plane relay station.

THE first successful attempt at using an airborne relay for intercontinental television trasmission took place last summer with Africa and Europe the continents involved. Planned and developed by *Radio Télévision Française (R.T.F.)*, this airborne relay was used twice. On July 14th, Bastille Day, programs originating in Algiers were relayed across the Mediterranean to France and telecast over the entire French television system, which covers roughly 80 percent of the country.

On September 4th, General de Gaulle's historic speech inaugurating the Fifth Republic was telecast throughout France and relayed across the sea to the North African television transmitters.

A single plane was used for both transmissions, the waves thus crossing the Mediterranean in two jumps. The first attempt will be described in some detail since both operations were practically identical. The feat becomes all the more remarkable when it is realized that the decision to relay the first program was taken on July 8th—just six days before the actual telecast. Only the video signal was transmitted *via* the airborne relay system to be described.

The Links

A special transmitter, radiating towards the plane, was set up in Bouzarea. It received the signal through two microwave links, one coming from the control center in Algiers and the other one from the Cap Matifou TV transmitter. Two links were used to insure continuity of the program in case of a failure in one of the microwave systems. Actually, no failure occurred.

The special transmitter had a peak power of 500 watts and used an antenna with a gain of 18 db. The antenna was oriented 15 degrees east of true north. The frequency was 173.4 mc. and the polarization horizontal.

This transmitted signal was received by the plane flying in circles of 12-mile radius at an altitude of 20,000 feet. The flight was made within a carefully chosen zone, east of the Balearic Islands. In the plane the signal was demodulated, amplified, and used to modulate a 500-watt transmitter which operated on 212.85 mc. and whose antenna was oriented toward France.

No automatic device could be relied upon to correctly orient the two antennas aboard the plane so two engineers, with the help of the gyro compass, continuously monitored and oriented the receiving and transmitting antennas. In France, again for precautionary reasons, two receiving stations had been installed—one near Marseille and the other in the Black Mountain range. This latter installation was the one actually used. Both receiving stations were linked by microwave to one of the TV transmitters of the national chain. The link used covered 120 miles in a single jump to feed the 200 kw. transmitter covering the southwestern portion of France. From there the program was distributed throughout the country over the permanent microwave-coaxial system that links the thirty-odd transmitters comprising the national network.

The Audio Signals

As mentioned previously, only the video portion of the transmission was relayed over the airborne link. To avoid unnecessary risks and to eliminate over-elaboration of the equipment which had to be carried by the plane, the sound was transmitted over an entirely different route. The audio portion was sent through the trans-Mediterranean submarine telephone cable, then through post office telephone links to Paris—from which point it was distributed over the television chain.

The engineer is orienting one of the directional antennas installed on the plane. Receiving equipment is at the right.

It is the custom in France to telecast on a nationwide basis only such programs as would be of national interest. However, there is a permanent system, called "Eurovision," linking together the national chains of practically all Western European countries. This means that programs of

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international interest could be telecast from England to Austria and from Norway to Italy at the flick of a switch. For example, the recent coronation of Pope John XXIII was transmitted from the Vatican *via* "Eurovision." Jet planes were used to carry both kinescope and video tape recordings of the ritual to the U. S. for early televiewing.

The French Air Force cooperated in these intercontinental TV transmissions by lending a "Bretagne" bomber, equipped for flight test of radar units, for the project. It had available a 27½-volt, 7 kw. d.c. power supply plus a rotary converter which provided 5 kilowatts of 50-cycle, 117-volt a.c. Because of weight limitations a 500-watt transmitter was considered to be the largest that could be handled.

The receiver was a high quality commercial model, modified to pass only 7 mc. instead of the 10.5 mc. of the 819-line French picture. The small loss of detail was compensated

Two 4-element retractable yagis were used beneath the fuselage.

by an improved signal-to-noise ratio. At 20,000 feet every signal within the frequency range came in loud and clear—radar, beacons, marine traffic, FM and TV stations from Italy and Spain, etc. The reception was considered proof of the advantage of reduced bandwidth in this application.

The video output of the receiver was visually controlled and fed to a sync signal re-generator which reshaped the line and frame sync signals. This completely re-generated signal was then fed to the 500-watt transmitter.

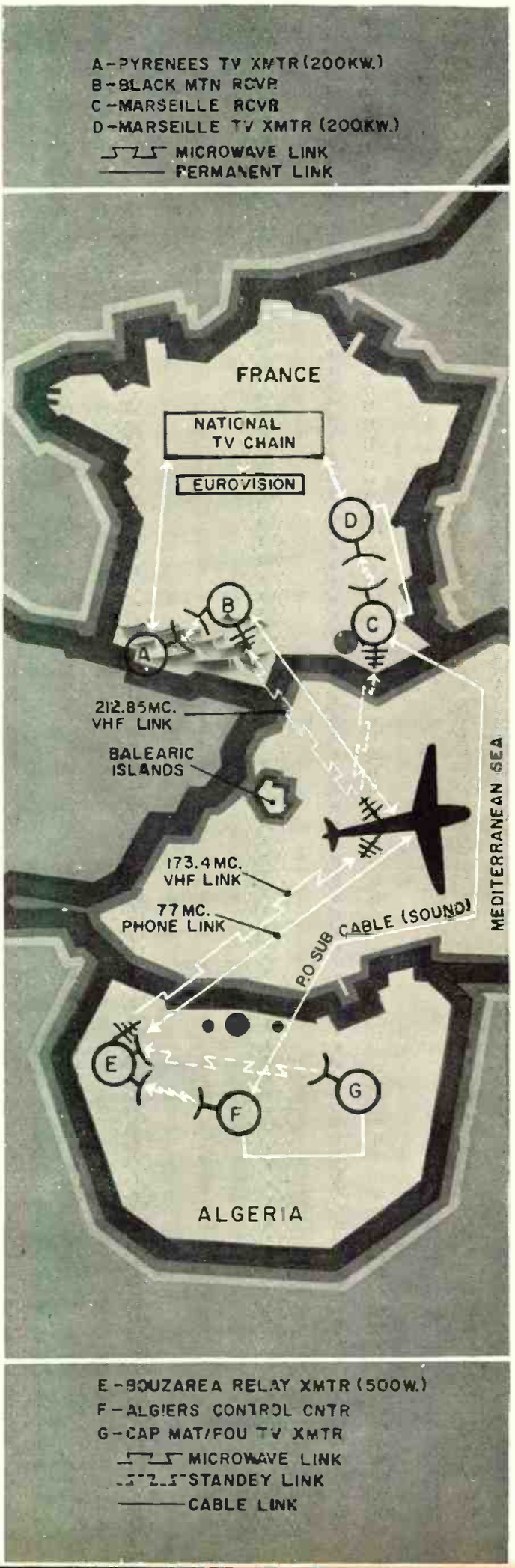
The transmitting and receiving antennas were simple 4-element yagis, connected to coaxial feeders through a bazooka circuit for good impedance matching. They were supported by retractable masts which could be extended to 8 feet below the fuselage after take-off.

The phone link on 77 mc. took care of intercom requirements between engineers on board the plane and in Africa.

The intense field, generated by the transmitter, permeated the entire plane and degraded the accuracy of the navigational equipment aboard. In addition, the engineers found it a full-time job keeping the transmitting antenna in line with the land-based receiving station. For this and other reasons, the signal received in France varied over very wide limits and a sync re-generator had to be brought into operation at the receiving sites. Although the reception was of somewhat varying quality, on the average it was about on a par with "Eurovision" programs originating in countries with 405- or 625-line systems.

These original results were bettered in the September telecast in which the direction of the program transmission was reversed. Previous experience with the airborne relay was of great help and, as a result, the picture quality, as received in North Africa, was decidedly improved ranging from fair to good.

All-in-all it can be said that the experiments were successful—demonstrating to engineers and the public alike the feasibility of such transmissions. These trials now take their place alongside a number of *R.T.F.* "firsts" which include direct transmissions from submarines, from deep sea diving bells, from caves, coal mines, helicopters, jet test planes, racing cars, etc. Perhaps the day of trans-oceanic TV is not as distant as we thought! —30—



Map at the right shows how signals originating in North Africa were relayed by a high-flying plane to France. Link was also used for signals originating in France and destined for Africa.

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SINGLE PUSH-PULL STAGE FOR BOTH STEREO CHANNELS

By **NORMAN H. CROWHURST**

Simple simplex-type circuit for stereo does away with two output tubes and one output transformer.

EDITOR'S NOTE: *The circuit discussed in this article aroused considerable interest when it was introduced in a paper presented by CBS engineers before the Audio Engineering Society. Here we evaluate the system, and answer some of the questions that have been asked about it.*

The importance of the circuit lies in the fact that two output tubes and one full-power output transformer are able to handle both stereo channels. There are some limitations to the flexibility of the input and output circuits, but from where we sit, it appears that the circuit will find widespread use.

As we go to press, the Heath Co., under license by CBS Laboratories, is investigating an inexpensive stereo system utilizing an improved and more sophisticated version of the principles described herein.

IF STEREO can be recorded in a single groove, why cannot it be amplified by a single amplifier? As with so many questions, this one has two possible answers: it can't be done; and the people who do it! In this case the latter are *CBS Laboratories,* as reported in a paper before the Audio Engineering Society, jointly authored by B. B. Bauer, W. S. Bachman, J. Hollywood and G. Maerkle.

The question, "How does it work?", which this article aims to answer, can likewise be asked with different attitudes: the man who said it can't be done has objections, and doesn't think it can work *properly;* while the person who is unprejudiced just wants to know, in simple terms, the principles involved, as well as "Does it do a job as good as two separate amplifiers, of the same, or lower cost, or with the same total output?".

In an ordinary push-pull amplifier, all the tubes and other components of the push-pull part are in duplicate, and handle audio exactly the same, except that one "pushes" when the other "pulls". For good push-pull operation, both "halves" of the amplifier carry identical waveforms, except that one swings up when the other swings down. Usually great care is exercised to ensure the two halves are balanced so the waveforms really are identical.

But actually a push-pull amplifier is two separate amplifiers, the only tie together being at the input, or phase inverter, and the output, a push-pull transformer. Failure to maintain the ideal balance would not cause any trouble until the two are recombined at the output. So what is to stop each side of the "push-pull" stage being used for one channel of stereo, instead of going to all that trouble to get exact identity for just one output? And when you look at it, the principle is quite simple (although one can always say that when someone else has already done it!). In fact it's as simple as making each half carry the modulation from one side of the record groove in a 45-45 record (Fig. 1).

By now it is well known that, when the two channels work together, as they do for a center-located sound, the groove moves from side to side without any change in depth (Fig. 1C). When only one channel carries program, due to a sound originating from one extreme side, only one wall of the groove is modulated (Fig. 1A or 1B). And when the two work in opposition, the groove goes directly up and down (Fig. 1D).

This last condition does not normally happen at lower frequencies, because it would represent a sound "off-stage". But it can and does happen at higher frequencies, because the time difference can then amount to several wavelengths.

From Fig. 1 it will be seen that the center-located sound gives the normal push-pull waveform combination, while the out-of-phase condition gives "push-push". Stereo program would be mono if it only contained the push-pull com-

Fig. 1. The relationship between various types of grooves on a 45-45 disc and the outputs from the stereo cartridge discussed in the article. Although coils are shown, ceramic elements would produce the same results. (A) and (B) show sound in one channel only, while both channels have equal signals in (C) and (D). In (C) the cut is completely lateral, in (D) it is vertical.

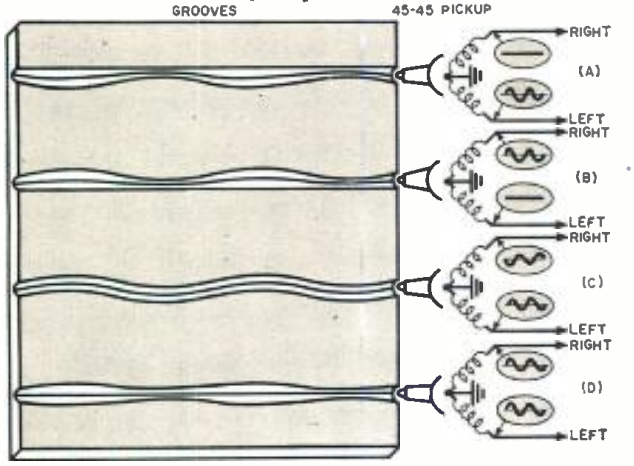

Fig. 2. The double-matrixing transformers operate push-pull and "push-push", or single-ended, to produce these waveforms.

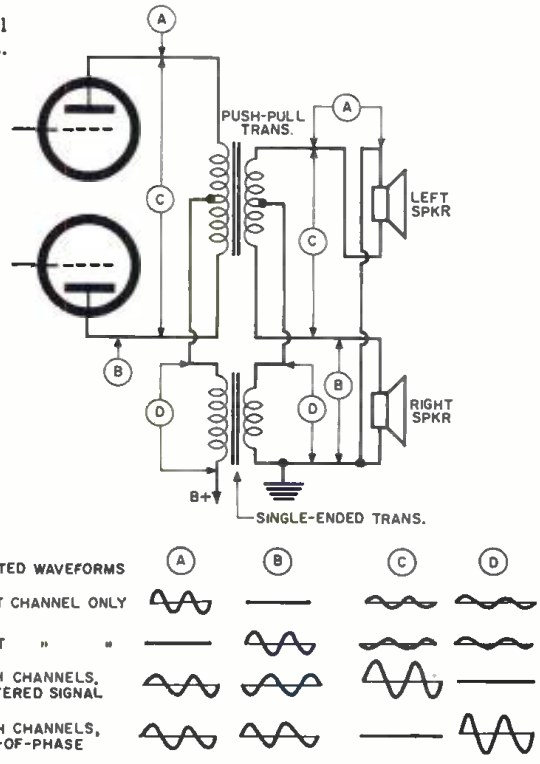

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Fig. 3

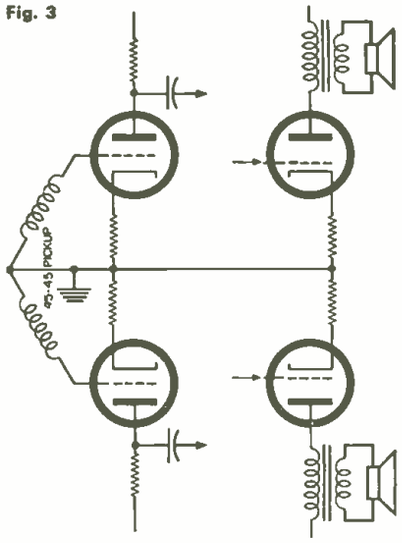


Fig. 3. With single-ended output transformers, a full-length, push-pull amplifier could be used as two separate single-ended amplifiers as described in the text.

Fig. 4

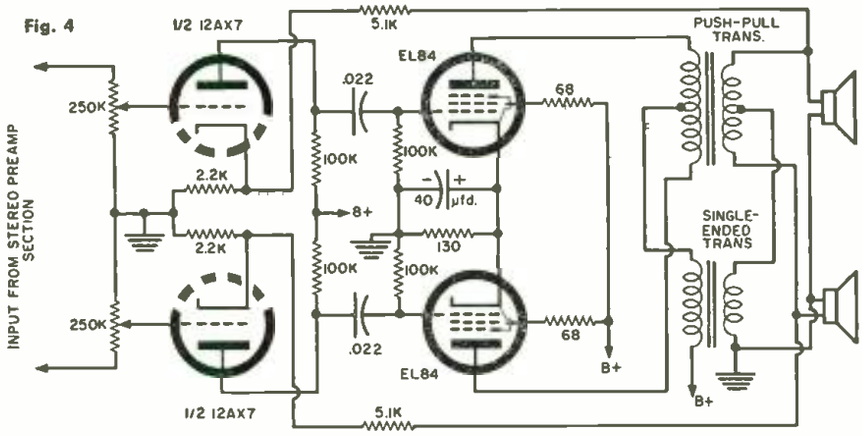


Fig. 4. Schematic diagram of driver and output stages, showing use of feedback.

Fig. 5

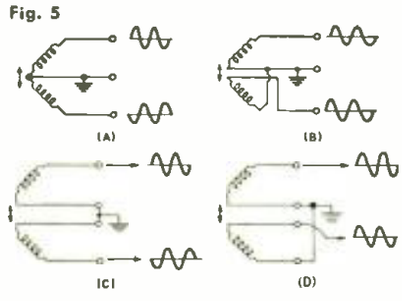
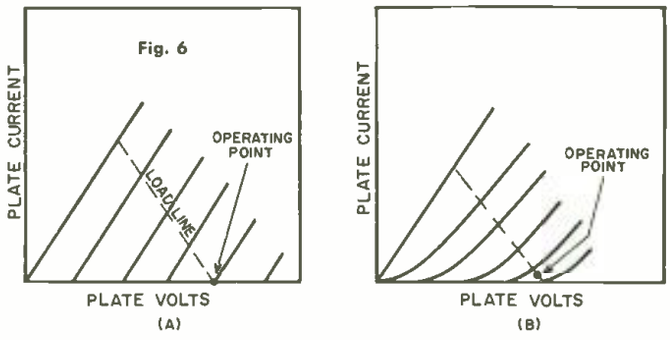


Fig. 5. The two possible ways a 3-terminal cartridge can be connected internally (A) for CBS push-pull system and (B) for "regular" separate system. A 4-terminal cartridge can be connected (C) for CBS system and (D) for "regular" stereo system.

Fig. 6. Class B operation is a condition not completely realizable in practice: it depends on "curves" with straight lines and sudden corners (A); practical tubes have bends (B).



bination, but on the other hand, very little of it reaches the completely push-push condition of simple up-and-down. Most of it lies somewhere between these extremes.

(Most common stereo cartridges are phased in such a way that lateral motion produces in-phase signals. By simply reversing the connections to one of the pickup elements, the phase conditions shown in the figure are obtained. With 4-terminal cartridges this is simply a matter of transposing 2 leads; with 3-terminal cartridges the manufacturer must provide the required phasing. See Ques. 2.—Editor)

If one pick-up output were fed into each side of the so-called push-pull stage, and each side had a separate output transformer feeding its own loudspeaker, we should have a couple of separate amplifiers working from a common power supply, of the quality normally expected using single-ended output stages (Fig. 3). The kernel of the new development is the double matrixing (mixing) output circuit that effects an economy in output transformer requirements, and *at the same time* enables the normal advantage of push-pull output to be obtained.

Instead of using one output transformer for each channel—left and right—separate transformers handle virtually the "lateral", or push-pull and "vertical", or push-push components (Fig. 2). Remember, the out-of-phase condition never normally happens in stereo program at low frequencies, and only stands a random chance of happening at higher frequencies.

So the transformer that carries the two plate currents in parallel does not need a good bass response. Thus the normal objection to a single-ended output—loss of bass—is avoided in having the transformer acting single-ended. The *CBS* paper also claims an advantage in downgrading bass response to the "vertical"—a built-in vertical rumble rejection, that certainly can often be helpful.

The other transformer acts strictly push-pull, and thus is able to have all the qualities of a push-pull output transformer. Now we begin to see where the saving comes in. Only *one* high quality push-pull output transformer is needed; the other can be smaller and much cheaper. And we need only one push-pull output stage, as regards all the other components, through which to feed stereo program material.

Feedback is taken from the resultant output to the voice coils, back to the cathodes of the driver stage (Fig. 4). This can reduce distortion in either channel (left or right), correct frequency response, and reduce any error in the double-matrixing action of the output transformers.

That about tells the story as far as the principle is concerned. But a new idea like this will start (in fact it has started) some questions, with the idea "Does it really buy all this?". So let's take some of these questions, as a way of exploring the potentialities of this kind of amplifier.

1. You said the push-pull transformer has all the advantages of a normal push-pull output transformer. I can see that the static, or quiescent plate currents will balance and thus maintain its inductance and low frequency response; but isn't part of the function of a normal output transformer to cancel even order distortion from the amplifier? How can this happen when the amplifiers are handling different channels?

This objection would be true for separate, single-ended output transformers (Fig. 3). But with this arrangement, the push-pull transformer only handles that part of the composite program content that is strictly push-pull. The "single-ended" component is handled by the smaller transformer. There is, in almost any stereo material, a dominance of high amplitude lower

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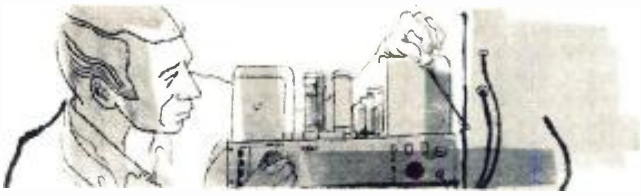


Service-Business Problems

By WILLIAM LEONARD

Unsound pricing, manufacturer service, and drug store tubes are three that confuse set owners.

IN DISCUSSIONS about the management problems involved in the operation of an electronic service business, it is interesting to observe the growing interest among dealers in the economics involved. The technical facets of service, which once dominated the thoughts of the majority of the independent service dealers, are being gradually eclipsed by the urgent demands for increased income to meet mounting operating and living expenses.

While the operation of a service business follows the pattern of any independently owned retail store in many ways, there is one significant difference: the service dealer must find ways and means to sell time, experience, and transportation costs at a profit.

A retail merchant operating on an average gross profit of forty per-cent is required only to have the needed merchandise on his shelves when a customer comes in to buy it. The major problem of this retailer is to develop enough volume of business at forty per-cent gross profit to cover operating costs, a better-than-average salary for himself, and a profit on his investment.

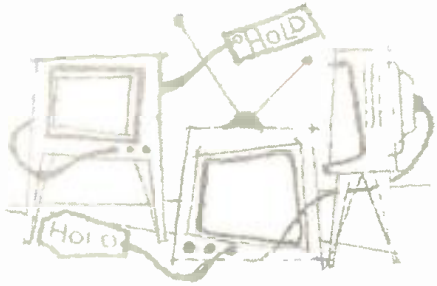
Assuming that three dollars per hour is a nominal price for the time, knowledge, and skill of an experienced technician, the service dealer who charges five dollars for a home service call gets the same gross profit percentage for his technicians' time as the retailer gets on the merchandise he sells. However, the service dealer has an additional operating cost that the conventional retailer does not have: he must deliver this skilled service to the customer's home. Thus, out of his forty per-cent, he must pay transportation costs in addition to the normal operating expenses of his business establishment.

The dual expense burden of maintaining a business location for the shop *and* transportation costs to perform service in the home led many dealers into some type of retail diversification as a means of taking a part of the shop's overhead load off the back of the consumer-service phase of the business. While this diversification has helped many dealers to lighten their overhead burden, they still find it necessary to get adequate charges for service work. An analysis of the ten foremost problems in the management of small service businesses indicates that the governing factor in their success is this very ability to get adequate charges for service time and labor.

The first of these fundamental management problems is that of maintaining an adequate volume of *profitable* business. This means that the gross profit over and above the cost of materials purchased must be sufficient to pay overhead and operating costs, provide the dealer with at least a normal income, and pay a return on the investment in the business. To accomplish all of these objectives, the dealer must make a satisfactory profit on service time as well as the normal profit on the tubes and parts he sells in connection with his service work.

Since a business must be *managed* if it is to prosper and grow, another dealer problem is that of allocating part of his time and attention to planning and promotion. In order to afford the time necessary to manage his business, he must make an adequate profit on the time he is in the field servicing sets.

One of the most serious problems of service management is that of maintaining an adequate stock of tubes to handle any tube-failure service job in one call. Here the dealer is faced with a double-sided problem. First, he has the investment to consider. A representative stock of tube types including an adequate number of those most-used, will require more money than the average small dealer can afford to tie up in that one element of his business. The second part of the problem is that of handling a tube caddy stocked with all of the numerous types that may be required in home servicing. As one dealer expressed it, "When one of the larger caddies is filled with tubes, it's one hell of a load to carry up three flights of stairs."



The fourth major management problem is that of determining the type of advertising that will produce the best results with the amount of money available for this phase of business promotion. To determine how best to use his limited advertising budget, the dealer should experiment with direct mail, newspaper, cards, and handbills to determine which produces best in his location and community. It takes time and unfettered thinking to plan and to evaluate results. This time must be paid for out of adequate profits from service calls.

A basic weakness in service management generally has been the failure to pursue consistently a studied promotion program. While word-of-mouth advertising has been the promotional mainstay of most ethically operated shops, it also is business that can be lost quickly to competent part-timers whose service charges are less than those of full-time shops. There is a marked public preference for dealing with stable, successful businesses. The only way the public can know about a dealer's business is what they see in the appearance of his shop and the manner in which customers are handled by phone and in personal contacts.

In the development of any business, there come times when it is wise to expand and other times when it is best to hold the line. The controlling factor in making the right decisions about expanding or maintaining the *status quo* is a sound understanding of the economic forces at work in the particular trading area. A service dealer should be personally acquainted with all of the other businessmen in his community to keep informed about what is going on business-wise.

Call-backs, another problem, are dually expensive. In the first place, it costs the dealer money to make them; in the second place, the average customer goes through a period of *loss of confidence* when it is necessary to call for service shortly after a set was fixed. Some dealers have drastically reduced

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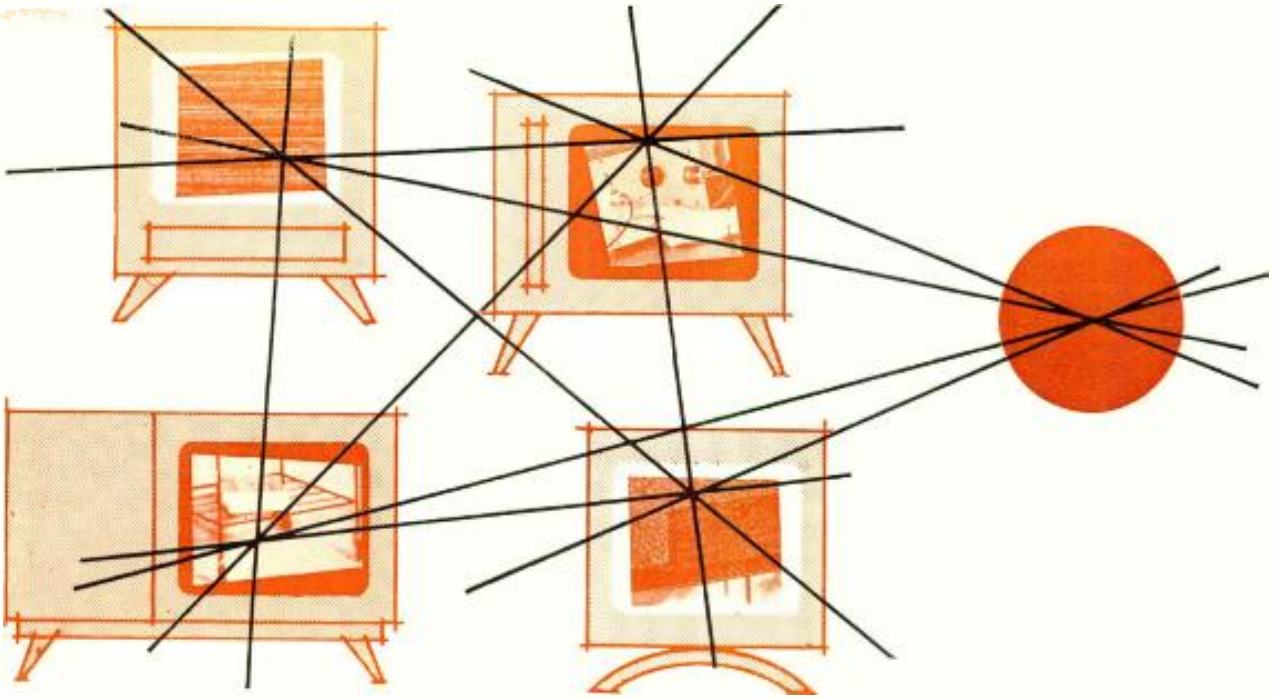

Practical Know-How for Multi-Set TV Installations

By **JACK BEEVER**
Jerrold Electronics Corp.

Building type and structure are important. Motels, hotels, and hospitals call for different techniques.

NO HARD and fast rules for wiring TV distribution systems in buildings with coaxial cable can be laid down—but certain generalities apply to practically all jobs. Familiarity with general technique plus a little ingenuity usually produces a specific, successful installation.

One thing is certain—the particular application may modify the layout of the job. The simplest, cleanest, and generally most satisfying approach to a system installation is to be found in a new building where conduit and outlet boxes have been placed as the building was constructed. As long as the conduit layout was made with a specific wiring plan in mind, the work of installation is simple. The only special tool needed is an electrician's fish wire.

Beware the job however, where the conduit for a TV system has been laid out by an electrician or draftsman who thinks that TV can be wired like a nurse-call system in a hospital. On these you can lose your shirt, since the building owners will insist on concealed wiring and the conduit layout may make it almost impossible. The author recently turned down a 200-room hospital installation because of this. Some runs had cable losses alone over 70 db! This ignorance of TV systems is a good break-in point for the technician who is looking for this type of work. By offering his services on layout of systems to an architect, he can make a friend and write his own specs, thus getting an immediate bidding advantage.

The harder jobs (and also easier ones) will come when existing buildings are being wired. Here is where much money and labor can be saved by a little preliminary cerebration, which is just a high-priced word for "horse sense."

The first thing to look for is the presence of "dead space"—areas which adjoin those to be wired, but in which it does not matter if the wire is not concealed. Such spaces are basements (unfinished), attics, or "crawl" spaces above or below finished rooms. Such spaces can accommodate feeder cables in the horizontal direction. When wiring is done so that feeders run vertically, "drops" (as in multi-floor buildings), air-vent ducts, elevator shafts, "furring" for pipe or conduit runs, and even closets such as broom closets may be used when these elements are placed one above the other.

When none of these vertically aligned spaces are available, interior wiring can be considered; and then, as a final resort, wiring concealed in special molding may be the answer. Of course the use of unconcealed wiring, always possible, needs no real discussion.

Let's consider the case where a dead space is available over the ceiling of a motel. At first glance, it looks as if the cable could be run across the ceiling joists, down inside the wall, to an outlet of the combined isolation and matching type, then back up to the dead space, across to the next room, down, up, and so on. This can be done. However, in modern frame construction, there will be a "fire stop" between the studs, usually about halfway up, as in Fig. 1.

The purpose of these stops is to prevent drafts from developing in the walls, thus slowing the spread of fire if one should occur. For the technician wiring a building, fire stops are a solid deterrent to running vertical wires in partition walls. If the job must be done, plaster must be broken above and below the fire stop and the stop itself notched to allow cable passage.

In the motel, advantage can often be taken of the closet. If the outlet can be placed on a wall that "backs up" on a closet, the cable may be brought through the ceiling of the closet, then through the wall of the closet into the back of the outlet, as in Fig. 1B. Usually there is no objection to the exposure of the cable in a closet as long as none is visible in the room.

When wiring can be done from a basement or crawl space beneath a one-story building, the fire stop is no deterrent. The difficulty here is in locating the points to drill up into the space between the plaster surfaces. The best technique here is to drill a small hole back an inch or two from the edge of the baseboard through the floor—a hole as small as possible, using a bit of about 1/16". Measure the distance to the face of the wall from the hole, drop a small piece of bright wire through the hole, then locate the wire below the floor. Knowing the distance from this point to the wall surface, add 2" to this measurement and then drill up into the wall. Fishing cable into the opening for the outlet is then no problem.

In either of these two wiring techniques note that the actual cable length has been increased over the point-to-point distances indicated on drawings. In wiring below the floor, an additional 4 or 5 feet may be added

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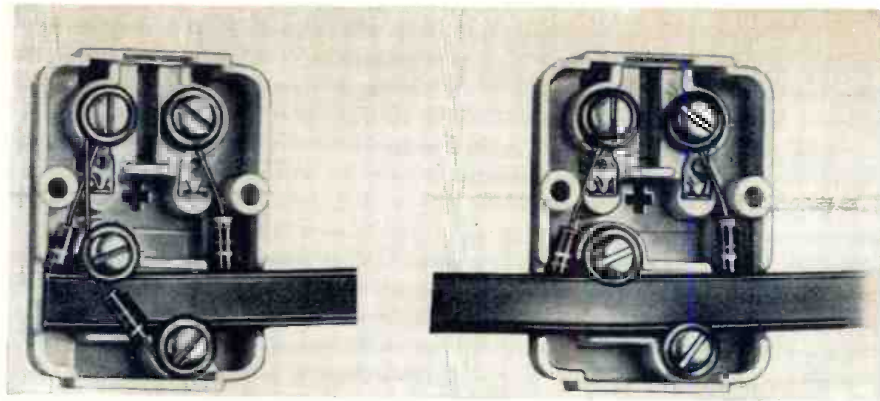
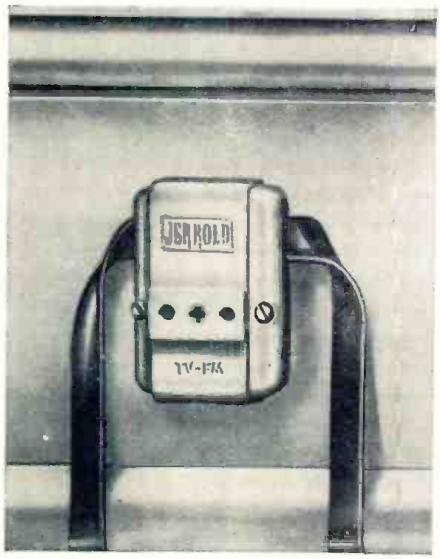
Multi-Set TV Installations



Inside view, from the rear, of two wall-mounting outlets for feeding TV sets. The extra resistor in the unit to the left is shunted directly across the 300-ohm line. It is used where the line is terminated in any given outlet. These units are used chiefly in modest, 300-ohm, home distribution systems.

← Front view of receptacles shown above and to the right, made by Jerrold.



One type of broadband v.h.f. distribution amplifier, the RCA SX-2LH, is designed for medium gain, medium-power output, and optimum v.h.f. response.

per room, which is usually insignificant. In the over-the-ceiling method, from 12 to 16 feet per room may be added—roughly an additional decibel of loss per room. This can be serious.

When confronted with this situation, a change in distribution technique may solve the trouble. We have been discussing the type of tap that combines isolation and matching in one container. By using the type that provides isolation in one unit and match in another, the over-all line length can be reduced.

Fig. 3 illustrates such an application. The isolation unit cuts into the line above the ceiling and a *single* coaxial line descends to the terminating outlet in the room. With this technique, the feeder cable itself remains very close to the length determined by point-to-point measurement. However, the *set* on a "drop" in such a wiring method sees the isolation loss of the tap-off unit *plus the loss in the drop line*. A building drop, usually only a few feet, can be neglected; but if some vagary of construction requires any considerable length this loss must be taken into account when determing set levels of signal at the receiver.

The trick of mounting outlets back-to-back when adjoining rooms are being wired should always be considered. Electrical outlet boxes are available that can be set into a wall in such a fashion that both sides are open, and each side will accept a standard outlet. When you are wiring a series of rooms, these can cut the number of descending and ascending cables in half. Fig. 2 illustrates this.

Care should always be taken that coaxial cable does not rest on uninsulated steam or hot-water pipes. The dielectric of these cables softens with heat and the center conductor can then "migrate" away from its central position. This changes the characteristics of the cable, causing a "lump" or discontinuity in the line, which can be a source of reflections. By the same token, cable fasteners should not be tightened excessively, since "cold flow" —a deformation resulting without heat —also occurs.

Many jobs must be done in buildings using solid walls, usually cement block but sometimes brick or tile. If the ceilings do not allow access or the dead space is too small to be usable, wiring can be run externally, usually under the eaves, but sometimes buried next to the wall. These cases almost invariably require separated isolation and matching units. Part of a typical installation using this technique is shown in Fig. 4. The closet trick can be used here, also: enter the closet high up, under the eave; then drop down to the appropriate level for the tap on the outside wall of the closet (interior of the room).

This method of installation is peculiarly adapted for existing hospitals, the feeder wires running around the sides of the building at a level just below the windows and drops going in through holes in the walls. The method has the advantage of very little interference with the interior of the building. If care is used, little or no plaster patching need be done. Each opening for a drop should be calked after the tap is mounted. Use an ordinary calking gun or the self-applicator types of calking compound available in hardware stores.

Hotels pose a special problem, but are usually very easy to wire nevertheless. Practically all hotels have vertical raceways built in, one raceway rising between each pair of rooms. These raceways may be ventilating ducts,

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wireways, or pipeways. They are usually "furred" into a column or a wall corner. (The term "furred," in construction work, refers to a false construction to hide a hollow space.) For example, many of the huge columns seen in large, open buildings are not as large as they look—they have been furred out to provide space for ascending and descending services.

When laying out a hotel installation, the wiring is done so that rooms are wired in "columns" vertically, not in horizontal "ranks," along a floor. The feeder lines are usually called "risers" (even though they may run down instead of up!). In nearly all cases, the outlet may be cut directly into the wall of the raceway. The feeder then drops from outlet to outlet. Where cutting the outlet into the wall is ruled out, the isolation tap can be used and a drop run exposed along a baseboard or under the molding to a terminating outlet. It is quite feasible to mix these tap-off units along a line so that one outlet is a combined type and the next the separated type. A peculiarity to note here is that there will be two rooms to each floor on each riser in most cases—watch this when figuring out line losses.

In any case, try to avoid exact periodicity in cutting taps into a line—try to keep a varying length of cable between each tap. When taps are cut in at exactly equal spacings, the small discontinuities caused tend to pile up an error at one frequency, which may result in a "suckout"—heavy attenuation occurring at one frequency or one small band of frequencies.

In this connection, the author recalls a case where some thousands of feet of RG-11 type cable had been run in the forming rolls during manufacture at a time when the forming rolls had picked up a quantity of some foreign matter. This resulted in a slight thickening of the cable's polyethylene dielectric, occurring regularly spaced at a length equal to the circumference of the rolls. This cable exhibited an attenuation of 56 db per thousand feet as compared to a normal attentuation of 18 db—*but only at 69 mc.* The net result was an impossibly distorted channel-4 picture. This was many years ago—and present-day manufacturers take precautions against such occurrences—but it shows the danger of periodic discontinuities. Practically all manufacturers of coaxial cables today sell, at a slightly higher price, cable that has been "swept," that is, it has been inspected by measuring the results of feeding signals from a sweep generator through it, thus exposing excessive losses at specific frequencies.

The sweeping technique, which is possible for a well-equipped service shop, is illustrated in block-diagram form in Fig. 6. The test is performed by first setting up the equipment as illustrated, but leaving the cable out, and using more attenuation in the variable attenuator than the expected cable loss. Thus a reference pattern can be developed on the scope that is really the combined response curve of the generator and amplifier. This may be recorded or traced.

Now the cable is inserted as shown in Fig. 6 and attenuation is reduced with the variable attenuator until the scope trace returns to the previously recorded height at any given frequency point. The amount of attenuation taken out is the loss of the cable, at the frequency involved. Since the curve will change shape, this check may have to be performed at various frequencies, which can be identified by markers. These curves will invariably show a ripple across the tap. As long as the ripple does not exceed 3 db, it can be ignored. Fig. 5 shows some typical curves across a single channel. The amount or depth of these ripples can be estimated closely by noting the amount of attenuation that must be taken out to bring the dip in the curve up to the average level. Two things need to be watched. The amplifier used must have more gain than the normal losses of the cable and care must be taken that the amplifier is not overloaded.

Speaking of amplifiers, certain precautions need to be observed in installing them, the first of which involves safety. These units develop heat and care must be taken that such heat cannot accumulate to cause a fire or amplifier damage. When equipment cabinets are used, they must be louvred or ventilated in some way to keep amplifier temperatures in the normal range.

The a. c. supply should be taken from lines not subject to sudden heavy loads that may produce excessive line-voltage variations. If installation must be made in areas of heavy vibration, such as occur in some elevator lofts (primarily those for freight elevators), shock-mount the amplifiers, using springs—not rubber. Springs of the type used on screen doors may be cut up and applied as in the old-fashioned microphone mountings.

Don't allow coaxial cables to flap or rub against surfaces. Perforation of the outer jacket allows moisture to creep in next to the braid, with consequent oxidation of this braid. This kind of rot can cause severe headaches for service personnel, since the cable slowly increases its losses. The process may take months, and the trouble is extremely hard to find. For the same reason, don't use coaxial cable that shows obvious signs of abuse.

One final word. Keep your instruments—field-strength meter, sweep generators, and marker generators—in calibration. -30-

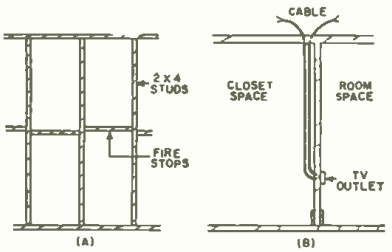


Fig. 1. Firestops (A) hamper vertical running of cables. However, closet space (B) can be used to hide wiring, with outlet on room wall of closet.

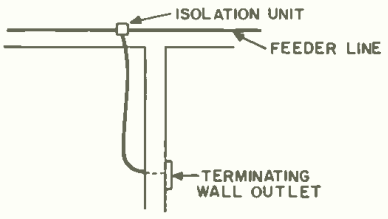


Fig. 3. Separate units for isolation and matching can reduce line lengths.

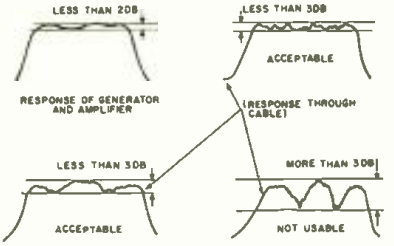


Fig. 5. To check cable by the sweep method, compare response of generator and amplifier (upper left) with that observed when cable is added to set-up.

Fig. 2. Wiring outlets for adjacent rooms back-to-back cuts line lengths.

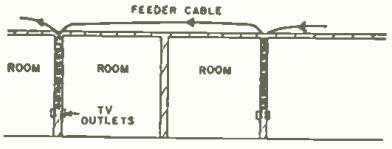


Fig. 4. If suitable wiring space is not available in the structure, external under-the-eave wiring can be used.

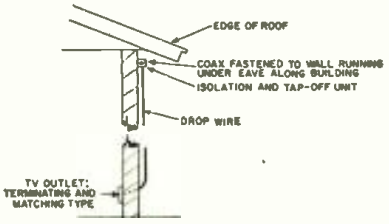
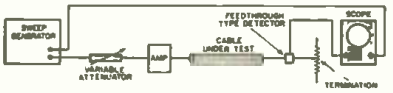


Fig. 6. This set-up for sweep-checking transmission line exposes undesired deviations in cable frequency response.



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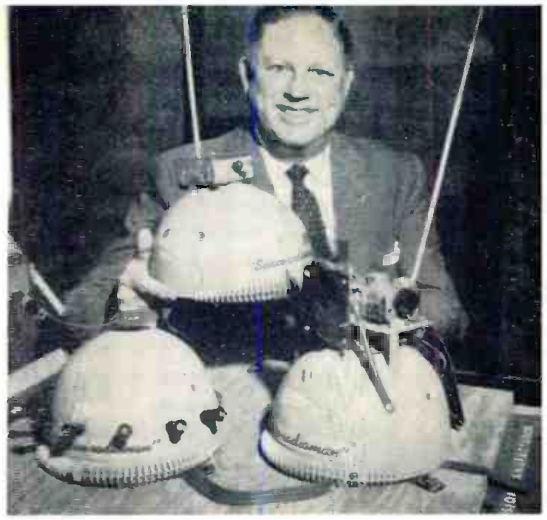
EDWIN B. HAINES

ALBERT P. KAZUKONIS



STANLEY EVERETT

All-American Service

VERNON TOWNSEND

BRYCE R. McNEELY

THEODORE W. FICKERT

VERNON E. BROOKS

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AT A PRESENTATION in Washington, D. C. on November 21, ten men stepped out of the ranks of TV service and into the limelight to accept trophies and $500 checks. They were receiving *General Electric's* 1958 All-American Awards from general manager Irvine D. Daniels of the *G-E* receiving tube department. Senator John Sparkman, of Alabama, one of the judges who helped select them, was speaker at the ceremony. Others on the award committee were Bennett Cerf, publisher and TV panelist, and Charles E. Shearer, 1957-58 president of the National Junior Chamber of Commerce.

The winners make an interesting comparison with the group chosen for 1957. The first list showed more men honored for single exploits, often involving their roles as hams in floods, plane crashes, and other emergencies. The 1958 group is stronger in men who have made marks in less dramatic, long-range projects reflecting civic and business responsibility. Many are active in service associations:

This year's list of ten television and electronic technicians honored by General Electric for unusual community services in 1958 reflects some interesting changes in emphasis as compared to the award winners who were similarly honored for 1957.

Technician Awards: 1958

WAYNE E. LEMONS

T. E. "BUCK" ADAMS

A. GEORGE CATAVOLO

EDWIN B. HAINES, Bloomington, Minn. (*Oxboro Radio & TV*), was outstanding in a home-town, youth sports program involving over 2000 youngsters in several sports. A Boy Scout leader, he is also active in the Centennial, Lions Club, and Civic League.

ALBERT P. KAZUKONIS, Brockton, Mass. (*Brockton TV*), instructs Boy Scouts and other youth in radio fundamentals, contributing time and materials. He is active in promoting better business ethics.

STANLEY EVERETT, Alhambra, Calif. (*Everett's TV & Radio Sales*), has contributed used TV sets to Parent-Teacher Association drives; developed a radio space hat to publicize fund drives for veterans' hospitals and other institutions; leads in civic work in Kiwanis Club, Masonic Lodge, Valley Businessmen's Association, Valley Boulevard Associates Committee, and the Community Church.

VERNON TOWNSEND, Menomonie, Wisc. (*Townsend's Radio*), provided radio communications during a tornado last June; devotes much time to civil defense emergency radio facilities and networks in Dunn County.

BRYCE R. McNEELY, Kelso, Wash. (*McNeely's Ace TV*), assists in a wide range of work from child safety to soil conservation; led a volunteer group in painting the home of an aging widow; donated a lot as a children's playground; is state v-p of the Junior Chamber of Commerce.

THEODORE W. FICKERT, Hatfield, Pa. (*Hoover's Radio-TV Sales & Service*), is a youth recreation leader; helped organize and held office in the local Junior Chamber of Commerce; served on the Boy Scout Council; is a Heart Fund leader; and promotes good community-business relations.

VERNON E. BROOKS, Norristown, Pa. (*Brooks Electric Co.*), led the American Business Club in sponsoring scholarships for therapists to work with paralytics, and in a fund drive for a school for the handicapped. He is active in the Chamber of Commerce, Red Cross, Community Chest, and other bodies, provides free service to religious and charitable groups.

WAYNE E. LEMONS, Buffalo, Mo. (*A-1 TV & Radio*), conducted after-class electronics courses in Missouri schools and has been active in Little League baseball and Rotary.

T. E. (BUCK) ADAMS, Channing, Tex. (*Adams Appliance & Hardware*), donated material and labor for electrical and plumbing work in his church. "He will do anything to help a fellow man," reports a booster, "repair a broken-down jalopy, pen a wild cow—where there is trouble, there you will find Buck at work."

A. GEORGE CATAVOLO, Somerville, Mass. (*Elm Radio & TV Service*), donates equipment, time, and service to schools, churches, and youth groups to promote electronics education and reduce delinquency. He has bought full-page newspaper ads ("Open Letter to President Eisenhower") urging improvement in education.

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By JOHN T. FRYE

Cold and Hot

MONDAY was not Barney's best day. Weekend dating usually left the Number Two Man of Mac's Service Shop pretty sleepy; so Mac was not astonished when he returned from lunch to find his assistant precariously perched on a high stool and slumped over the service bench with his tousled red head pillowed on his folded arms, sound asleep.

Mac glanced from the figure at the bench down to the tall round can he carried in his hands; then he noiselessly removed the protecting cap from the spray nozzle on top of the can and tiptoed quietly across the room. Holding the can several inches from the head of the sleeping youth, he depressed the valve. A white, disappearing cloud hissed forth and played around the nape of Barney's neck.

With a yowl of surprise the boy leaped to his feet. "Wow! What a draft! Must be getting lots colder outside," he exclaimed as he rubbed the back of his neck. "Oh, oh!" he continued as he spied the can in Mac's hands; "what are you up to?"

"That's your cold draft," Mac said with a grin as he punched the valve again. "It's *General Cement's* 'Spray-Koat Circuit-Cooler'."

"So what's it good for besides going around annoying innocent people?" Barney asked with a huge yawn.

"It's actually freon gas under high pressure," Mac explained. "You use it on a circuit component you suspect of being temperature-sensitive. When this gas hits a radio part, that part gets very, very cold in a great big hurry."

"Hm-m-m-m, you're filtering through to me. That ought to be just what the doctor ordered for those radio and TV sets that display intermittent symptoms when they are first turned on. After these sets warm up a bit, the annoying condition disappears until the set is turned off and allowed to cool down completely; then it's right back. When you're trying to troubleshoot one of these little dandies, you have to act fast and catch it cutting out when it's first turned on or you're out of luck. They are great time wasters. In the past I've seen you put these sets outside in the winter or in the refrigerator in the summer to make them good and cold. Now we can put the chill on them right on the bench with that bottled north wind."

"And the good part is we can make that north wind blow exactly where we want it. We can cool off a small section of the circuit—or even a single part, such as a dubious capacitor—without affecting the rest of the circuit. And don't overlook the fact that it can also be used on those sets that cut out *after* they get warm. You simply spray a section of the circuit at a time until the set starts to operate again. That tells you where the defective component is. When the set cuts out again, you can cool off a part at a time. When the right one is chilled, it will make the set come back on."

"Man! That's real cool!"

"There are some horse-sense precautions to observe in using the stuff. For one thing, don't play the spray on the skin at close range. It will actually freeze a chunk of the flesh in nothing flat. The salesman was telling me one of their boys was demonstrating the stuff by squirting it on the palm of his hand, and he developed a nasty 'burn' that was really a frostbite. The closer the nozzle is held to an object, the colder that object gets. You will see a sort of rime appearing on an object sometimes, but it disappears immediately. I'm told the gas leaves no residue to interfere with electronic action."

"I suppose another horse-sense precaution is to see the spray doesn't fall on a hot glass tube," Barney observed. "I'll bet you could really crack a rectifier bulb that way."

"You certainly could," Mac said as he placed the can on the shelf with the imposing array of chemicals used in service work. There was contact cleaner, corona dope, cement solvent, alcohol, carbon tetrachloride marked with skull and crossbones, acrylic spray, "Lubriplate" and silicon gel, and recorder head cleaner.

Mac picked up a high-voltage doorknob capacitor from the bench and favored it with a sour look.

"Wish I could work out a quick and accurate way of checking this cuss," he commented. "It really gave me a hard time. The set came in with no picture. Checking revealed the high voltage was only about three or four kilovolts. The first thing I did was put the ohmmeter of the v.t.v.m. that reads up to 1000 megohms across the capacitor. It showed no leakage at all.

"A drooping high-voltage symptom is often a headache because it can be produced by so many different circuit defects. The accompanying symptoms did not help much, either. The boost voltage was low, but cutting in an outboard boost voltage supply did not restore the high voltage. Neither did changing the horizontal oscillator, horizontal output, damper tube, or high-voltage rectifier. The waveform at the grid of the output tube was somewhat lower in amplitude than rated, but this was not enough to cause the trouble. I checked the output transformer for shorted turns, but nothing was wrong.

"I happened to touch this capacitor while I was making the last test, and it was noticeably warm. I determined to cut it entirely out of the circuit, even though this took a bit of doing. When I did so, the high voltage flipped right up. Replacing the capacitor restored everything to normal; however, it was necessary to replace the high-voltage rectifier that probably had been damaged by the heavy current drain.

"But then I started trying to find a check of this capacitor that I knew to be bad that would show it so. I had absolutely no luck. I used our ohmmeter that places 450 volts across the test leads and reads up to 20 megohms, but this capacitor showed no more leakage than a brand new unit. Next I tried our leakage tester that uses a neon bulb to indicate leakage resistance up to 500 megohms, but this also failed to show anything wrong.

"I've finally concluded the capacitor has no leakage until a certain critical voltage is reached; then it abruptly develops a comparatively low resistance. Any attempt to test the capacitor with voltages below this critical potential must fail to show anything wrong. I was talking this over with my friend, John, who works in an experimental laboratory and also does some TV service work. He was telling me he had run into identically the same thing and had decided to see what happened to the capacitor when it was subjected to an increasing voltage. The lab has a source of d.c. voltage that can be increased from zero up to twenty thousand volts and he put this on the defective capacitor. When the voltage reached about 5000 volts, the capacitor suddenly shorted and exploded and blew bits of itself all over the lab."

(*Continued on page* 112)

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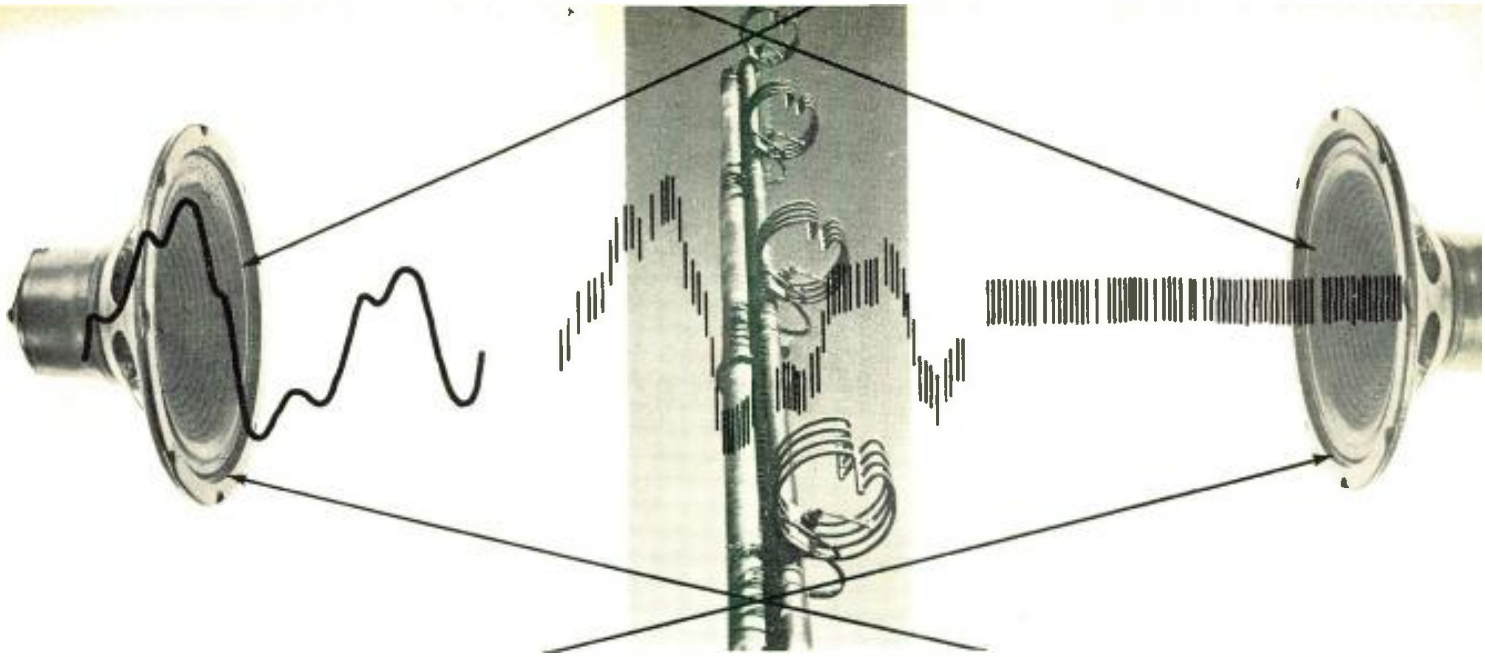


FM MULTIPLEX -ITS PRESENT AND FUTURE

By **PAUL F. HILLE, Jr.**
Polarad Electronics Corp.

Part 1. Authoritative article on basic principles of a technique that promises stereo from a single FM station.

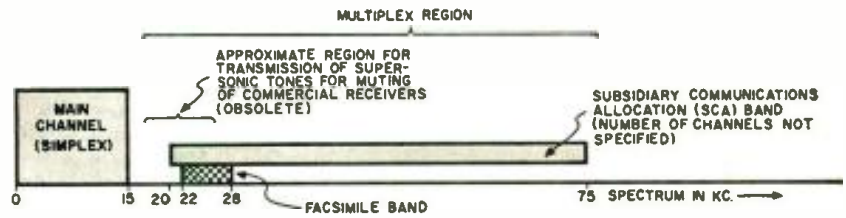
SEVERAL years ago the inception of color television provided the electronic industry with a practical example of r.f. spectrum conservation. To what was generally considered to be an already crowded television frequency band, engineers managed to add a significant amount of information necessary for the effective transmission of TV programs in full color. Concepts involving modulation and demodulation in suppressed-carrier processes, band limiting, and phase considerations were employed in addition to the previously common techniques associated with conventional amplitude-modulation systems. Of special significance is the fact that this color information was incorporated (theoretically, at least) into the standard monochrome transmissions without appreciably affecting the technical quality of the latter.

The matter of spectrum conservation has been of special import to FM broadcasters for some time. Many critics of frequency-modulation transmissions have been able to argue effectively that the spread of a 50 to 15,000 cps audio band over an r.f. frequency realm some 200 kc. wide is, at best, extremely extravagant when the lack of channel space for commercial and military applications is acute. Not at all impressed by the efficacy with which an FM system distributes its modulation energy over a wide spectrum, these critics have pointed out that the relative amount of energy per sideband pair is often very low in high-deviation transmissions. Faced with mounting objections from this quarter, and also taking cognizance of the fact that many FM stations are having difficulty in marketing their programming commercially, the FCC finally allowed a limited type of non-broadcasting operation within the standard frequency-modulation band from 88 to 108 mc. The fact that these point-to-point transmissions have been taking place for the past three years without the average FM listener being aware of them attests to the technical merits of the process. Practically, these allocations have enabled many FM stations to offer long periods of high quality classical music with few commercial interruptions while still allowing the station to sell other facilities to the industry and business at a reasonable profit. Strict engineering standards prevail, however, so that the normal broadcast aspects of FM transmissions are not adversely affected.

Fig. 1 shows the presently allocated *audio* spectrum of stations in the standard commercial FM band. It is important to realize that we are considering the audio-modulation spectrum of the station and not the actual 200 kc. r.f. channel allocation. In effect, it may be said that the multiplex spectrum is only available after the demodulation process at the receiver, although it will be apparent that the r.f. spectrum of the transmission will also reflect the additional information being transmitted by the fact that more sidebands are in existence in areas where none would normally be situated in standard simplex operation.

From Fig. 1 it may be observed that the audio-modulation spectrum has been defined as far as 75 kc., 55 kilocycles of which can be called the multiplex region. The multiplex region itself is divided into two sections, a facsimile band occupying the spectrum from 22 to 28 kc. and a subsidiary communications band from 20 to 75 kc. With respect to facsimile broadcasting,

Fig. 1. Audio modulation spectrum of FM stations. In addition to the 15 kc. band reserved for the standard broadcast transmissions there are available several other services to a commercial consumer. The subcarrier modulation used in the facsimile band can be either FM or AM; in the SCA band. AM is not permitted. Stereo transmissions will probably be made in a part of this band. Refer to text.



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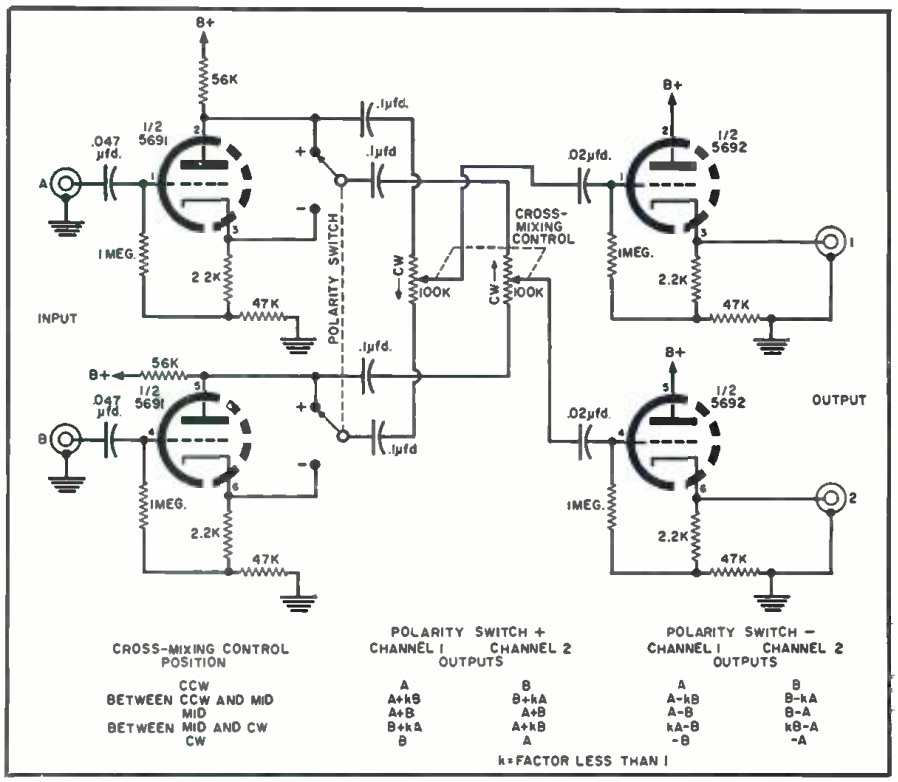


Fig. 2. A cross-mixing amplifier used to balance two stereo channels. This circuit is essentially that which is used for the AM/FM stereo transmission system shown in Fig. 3B. It may also be used to advantage in home music systems.

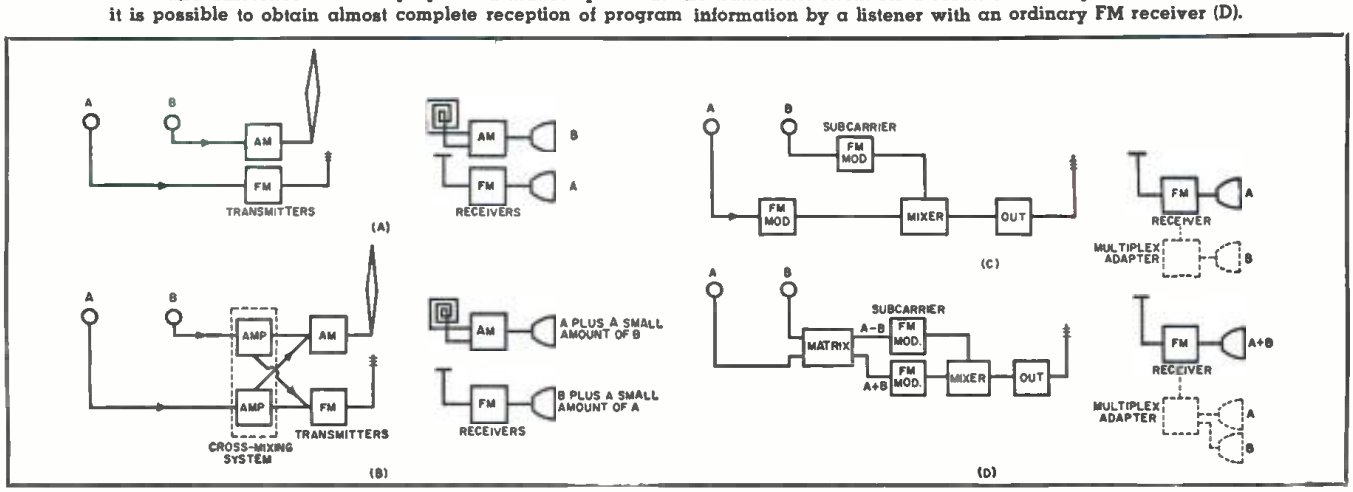
it will suffice to indicate that either amplitude- or frequency-modulation of the subcarrier is permitted; with the AM sidebands or instantaneous subcarrier frequency not extending outside of the 6 kc. band. To protect the main channel from the raucous sounds associated with crosstalk from a facsimile transmission, the main FM carrier cannot be modulated beyond 5% (of ±75 kc.) by the subcarrier and its sidebands. The SCA (Subsidiary Communications Allocation) band is restricted to use as a medium for the transmission of commercial material of a nonbroadcast nature, such as background music, news, stock quotations, and the like. It is particularly important to remember that, according to law, these are *private* point-to-point services and it is unlawful for unauthorized persons to derive remuneration from such transmissions. Unlike the obsolete method of muting certain portions of normal simplex FM programs by means of supersonic tones, the multiplex system effectively removes the commercial service from the home listener.

Technically, the SCA band is interesting because very little was specified concerning operation therein except that the system be frequency modulated and restricted to the allocated region. Persons familiar with FM theory will realize that a relatively large number of possible modes of operation are practical within such a spectrum. As an example, consider the operations outlined in Table 1. Assume we have two modes of subcarrier modulation, the first with a peak-to-peak deviation occupying 3.5 kc. and the second with a p-p deviation of 16 kc. Although the sideband distribution of the latter extends to a maximum of 40 kc., as against 30 kc. for the former, both may be operated within the SCA band at the same time since their peak deviations add up algebraically to only about 20 kc. In other words, the spectrum allocation is based on instantaneous frequency of the subcarrier and not on the position of the last sideband in the subcarrier modulation spectrum. Because of crosstalk considerations, however, the average FM station is usually content with one, or at most two, subcarrier channels—with a guard band conveniently placed between. In addition, as Table 1 shows, it must always be remembered that the minimum sideband distribution for an FM signal can, at best, be only equal to that of an AM signal with the same modulating frequency. This is another way of saying that there must be *at least* one pair of sidebands spaced *f* distance from the carrier, where *f* is the audio modulating frequency.

Crosstalk

Before moving on to a discussion of actual circuitry in connection with multiplex systems, it is worthwhile to mention briefly some of the aspects connected with the problem of crosstalk. As far as the FCC is concerned, the crosstalk problem connected with multiplex operation is significant only with respect to its effect on the main channel. Establishing limits on this interference assures, as was previously mentioned, the high quality of reception associated with FM broadcasting. The actual specification, as applied to frequency modulation of the main carrier by the multiplex operation(s),

Fig. 3. Several simplified versions of stereo transmission and reception. The method shown in (A) represents the conventional method of AM/FM stereo transmission which has been criticized on several counts. The system of (B) attempts to remedy one obvious fault of (A) in that listeners with only one mode of reception will receive only half the program information. The transmission system in (C) is obviously unsatisfactory for reasons similar to those rejecting (A). The "sum and difference" method proposes a matrix system at the transmitter itself. As a result of this important technique it is possible to obtain almost complete reception of program information by a listener with an ordinary FM receiver (D).



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states that such interference must be at least 60 db below 100% modulation (the latter in FM transmission is equivalent to a deviation of ±75 kc.) in the simplex band from 50 to 15,000 cps. This means that if the main channel audio output of an FM receiver discriminator is 1 volt peak-to-peak for a simplex transmission, any residual audio modulation related to the *multiplex* operation(s) can have a maximum superimposed amplitude of only one millivolt. Since most commercially available home receiver systems are not capable of resolving a dynamic range of this magnitude, it can be assumed that the multiplex operation will go unnoticed by the casual listener.

While the transmitted audio-interference component of the multiplex channel impressed onto the main channel should not exceed the −60 db level just indicated, the amount of *modulated subcarrier* superimposed on the main-channel detected audio output in the FM tuner may go as high as 10 db below 100% modulation. This corresponds to 30% modulation of the main carrier by the subcarrier(s) and would result in a .33 volt peak-to-peak signal riding on our previously established 1 volt p-p reference (see Figs. 4 and 5). For SCA operation, this .33 volt p-p component must be a frequency-modulated signal, so that with reasonable precautions following the discriminator in the receiver and in subsequent amplifier systems there should be little difficulty in preventing undesired subcarrier demodulation. This condition would be quite different if an AM subcarrier were used, as is the possibility with facsimile multiplex transmissions. Since there are usually many possible sources of amplitude non-linearity in conventional home receivers and amplifier systems, there would be a good chance that an AM subcarrier would be demodulated somewhere along the path from FM discriminator to loudspeaker. Depending on the amount of demodulation which could result, the existence of such an AM subcarrier might well be objectionable. This is one reason why modulation of the primary FM carrier by the subcarrier in facsimile multiplex transmissions must be held to a maximum of 5% (of ±75 kc.), resulting in a maximum superimposed subcarrier component of 50 mv. in the reference receiver.

In relating the relative amounts of the various components at the output of the receiver discriminator, it must also be mentioned that an FM station cannot legally exceed 100% modulation of the main carrier under any condition, irrespective of the possible presence of one or more subcarrier channels. This explains why stations which engage in multiplex operation produce less volume in a conventional FM tuner than their counterparts without subcarrier transmissions. In other words, the peak-to-peak amplitude of the composite modulating signal shown in Fig. 5B must not exceed the p-p amplitude of the signal in 5A, if the latter represents 100% modulation.

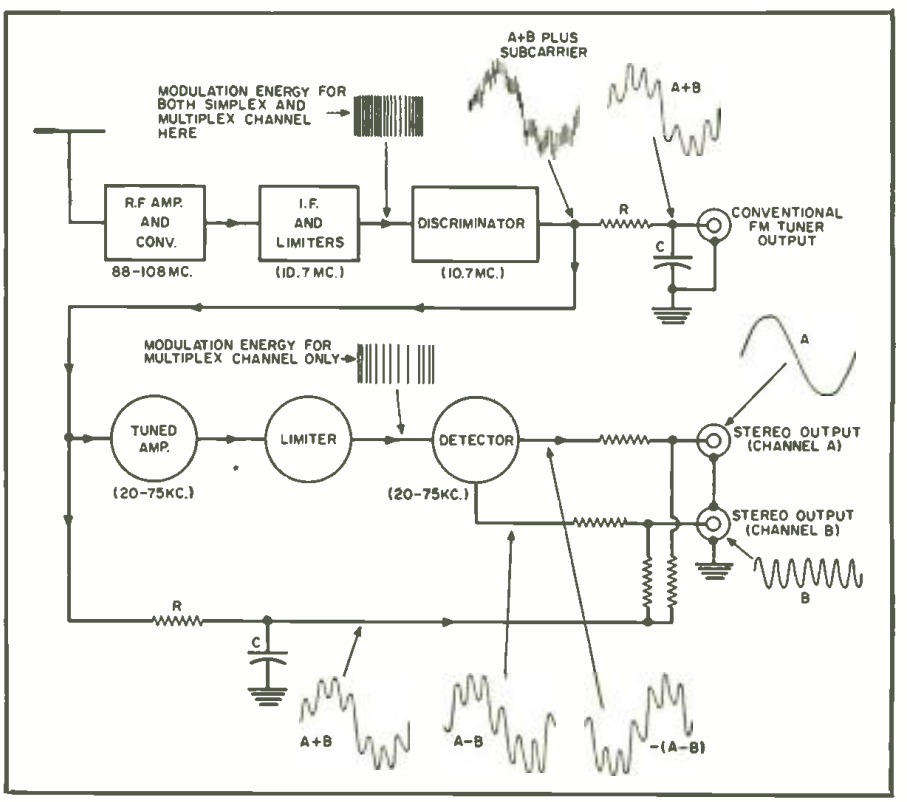
In the matter of crosstalk just discussed, there are two items of importance which were ignored. One is the effect of the de-emphasis network which follows the detector in standard FM receivers. Because of the 6 db/octave slope of this network, the subcarrier component will be attenuated by at least 20 db relative to 1 kc. at the detector output, thereby considerably reducing the problem of crosstalk in following circuits. Of course, it must not be forgotten that any inherent phase distortion in the circuitry *preceding* the discriminator in an FM tuner will also play a part in raising the level of cross modulation and will produce effects which are far more detrimental to the multiplex channel than to the main channel. This may be readily conceived by considering the relative modulation energy contained in the main channel as opposed to the secondary channel. For these reasons most FM stations which operate a multiplex service not related in modulation content to the main channel find it necessary to eliminate the subcarrier during silent periods in the multiplex

(*Continued on page* 139)

MODULATING FREQUENCY (cps)	MODULATION INDEX β	NO. OF SIDEBAND PAIRS GREATER THAN 5% OF UNMODULATED SUBCARRIER	REQUIRED CIRCUIT BANDWIDTH (kc.)
		(Subcarrier Deviation = ±1.75 kc.)	
75	23.40	21	3.75
300	5.80	8	4.80
1000	1.75	3	6.00
6000	0.29	1	12.00
10.000	0.18	1	20.00
15.000	0.12	1	30.00
		(Subcarrier Deviation = ±8 kc.)	
300	26.7	21	16.00
1000	8.00	10	20.00
6000	1.33	3	36.00
10.000	0.80	2	40.00
15.000	0.53	1	30.00
		(Subcarrier Deviation = ±25 kc.)	
1000	25.00	21	52.00
6000	4.16	5	60.00
10.000	2.50	4	80.00
15.000	1.66	3	90.00

Table 1. Sidebands and bandwidth for transmission with subcarrier having 6.4%, 29%, and 91% modulation. A ± 27.5 kc. deviation (covering the entire subcarrier band from 20 to 75 kc.) would be equivalent to 100% modulation.

Fig. 4. Block diagram of conventional FM receiver and single-channel multiplex adapter showing signal waveforms throughout the receiving system for the "sum and difference method" of stereo transmission. Most of the subcarrier is eliminated by the de-emphasis networks R and C. The waveforms are drawn for two pickup frequencies of 1 kc. and 7 kc. on stereo channels A and B respectively.



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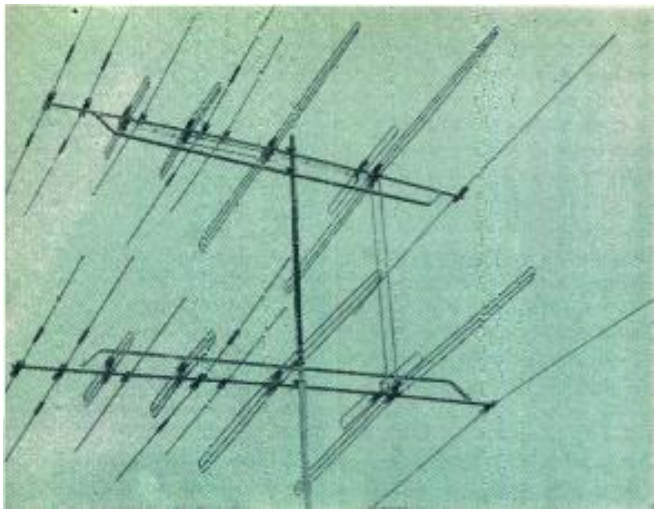
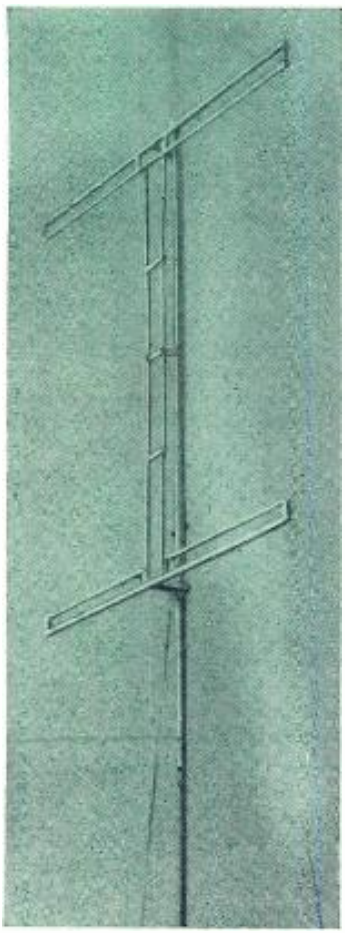


By **WALTER H. BUCHSBAUM**
Television Consultant, RADIO & TV NEWS

If more signal is what you are looking for, haphazard connection of more than one unit won't get it. Here are the things to take into account.

The Right Way to Stack Antennas



Arrays on this page suggest the broad possibilities of stacking. A 2-bay conical appears at the upper right, a 2-bay yagi at upper left. Two stacked dipoles are directly above, and a 4-bay conical is shown at the left.

WHENEVER the signal obtained from one antenna proves insufficient, the possibility of using two antennas immediately suggests itself. It is generally understood that the spacing and connections of two or more antennas must be arranged in a certain way to get stronger signals. Most of our readers also know that two antennas do not give simply twice as much signal. As a matter of fact, the theoretical maximum from two antennas is considered to be 1.56 times the (voltage) signal strength from a single antenna, or 3.86 db.

Whenever two antennas are brought near each other, they will affect each other's impedance and pickup characteristics as well. As they are spaced farther apart, this interaction will be less. However, if they are spaced too far apart, it becomes difficult to connect them together properly, and losses in the connecting lines eventually nullify any advantage of using two antennas.

The simplest case of stacking involves the use of two identical antennas, spaced one above the other and connected by quarter wavelength matching stubs, as shown in Fig. 1A. Although half-wave dipoles are shown here, all of the data applies just as well to the stacking of yagis, conicals, or any other antenna types. Every antenna configuration has a characteristic impedance which is made up of a variety of different factors such as radiation resistance, inter-element mutual impedance, and others. For our purposes, only the sum total—the characteristic impedance at the antenna terminals—is important. In the example of Fig. 1, this characteristic antenna impedance is called R_1 for the upper and R_2 for the lower antenna. In the case of simple dipoles, this would be about 73 ohms for each; but most TV antennas tend toward a 300-ohm characteristic impedance. Before any stacking arrangements are considered, this impedance must be known: manufacturer's data sheets should be consulted if any doubt exists. The second impedance that must be known is the characteristic impedance of the transmission line. For most TV installations, conventional 300-ohm twin-lead is used.

Fig. 1B shows the electrical equivalent of the antenna stacking arrangement of Fig. 1A. Each antenna is represented as a voltage source and a resistance (R_1 and R_2) and each quarter wavelength ($\lambda/4$) matching stub is shown as a transformer. The primary of each transformer is connected to the antenna impedance. The two secondaries are connected in parallel to the terminals (T_1) of the transmission line. We know that the impedance looking into the transmission line at T_1 should be 300 ohms. Therefore, the impedance looking out of each matching-stub transformer must be 600 ohms, so that the parallel combination is correct.

Fig. 2 shows the configuration of a matching stub that is one-quarter wavelength long. The same operation is obtained with 3/4, 5/4, etc. wavelengths —any *odd* multiple of a quarter wave. At one end is the antenna impedance R_1 and at the other the desired impedance R_T, which should be connected across the transmission line. If we assume that we wish to match two 300-ohm TV antennas to a 300-ohm transmission line—a usual case—then each matching stub must transform the 300-ohm antenna impedance R_1 into a 600-ohm impedance R_T. This is accomplished by making the characteristic impedance of the matching stub itself a value between the 300- and the 600-ohm end impedances. To be precise, the matching-stub impedance R_s must be the square root of the product of

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the two end impedances, as shown by the first formula in Fig. 2. For our example, this turns out to be 424 ohms.

Just as the characteristic impedance of a parallel-wire transmission line is determined by the diameter of the conductors and their spacing, so is the matching-stub impedance. This relationship is given by the second formula for R_o shown in Fig. 2. For this example, R_o is 424 ohms. This must therefore equal 276 *log* $2D/d$ where D is the center-to-center separation and d is the diameter of each conductor. The larger the diameter of conductors used, the greater will be the required separation D to obtain a given impedance for R_o. Conversely, the lower the impedance R_o, the closer the two conductors would be for a given tubing diameter. Since available wire or tubing would be used to make up the stub, R_o and d would be known at the start, and the formula would be solved for D, the separation between conductors.

The wavelength *in free air* is the same for matching stubs and for antenna separations. However, if the matching stubs are made up of insulated twin-lead, wavelength measurements become shorter. Any insulating material, such as polyethylene, slows radio waves down; therefore, the wavelength will be shorter than in free space. For simplicity, then, stacking bars should be made up of bare rods or tubing.

In Fig. 1A it appears as if the spacing S between antennas is less than a half wavelength. Actually, appreciable spacings *up to* a half wavelength will increase the signal strength. The maximum gain possible with good impedance matching is shown in Fig. 1C for various spacing values. Note that half-wave spacing gives the best gain.

To illustrate how two typical 300-ohm antennas can be stacked to give up to an additional 3.86 db of gain, consider the case where it is desired to improve reception on channel 4. (Since matching elements are resonant affairs, good broadband operation becomes less feasible as antennas are stacked. More will be said about this later.) We must first determine what a quarter wavelength is for channel 4. A wavelength in free air is determined by the formula $984/f$, where f is the frequency in megacycles and wavelength is in feet.

Since the metal bars of which the matching transformers will be constructed reduce wavelength to some extent, a better formula to use, which will take the reduction into account with sufficient accuracy for most cases, is $936/f$. The formula for a quarter wavelength, then, is $234/f$. The mid-frequency of the channel-4 bandwidth (66-72 mc.) is 69 mc. Thus 234/69 is 3.4 feet.

Having thus determined the length of the two parallel metal rods or wires, we must decide how far apart they must be spaced to obtain the desired impedance match. Let us assume that metal rods with a cross-sectional diameter (d) of half an inch are being used. R_1 and R_2 are each 300 ohms. The impedance of the line is also 300 ohms. Therefore R_T must be 600 ohms, since 600 in parallel with 600 is 300 ohms, which is the line impedance we wish to match. Thus, from the first formula in Fig. 2, the impedance of the stub (R_o) must be the square root of 600 x 300. This is 424 ohms.

With R_o and d known (½-inch diameter tubing is assumed), we can solve the second formula for the spacing (D) between the centers of the two conductors. This comes out to 8.58 inches. Log tables or the log scales of a slide-rule can be used. For those who wish to avoid encounters with logarithms, the spacing just worked out will cover that multitude of cases where 300-ohm antennas are being matched to 300-ohm lines; *i.e.*, where the matching impedance R_o is equal to 424 ohms.

Where R_1 and R_2 are 72 ohms and R_T is 600 ohms, as is the case with other antennas, R_o is 208 ohms. To obtain this impedance, spacing D should be 1.42 inches. Since there should be no particular problem in working out R_o for any application, spacing D, using ½-inch diameter tubing, is given for several values of R_o: for 200 ohms, 1.3 inches; for 300 ohms, 3 inches; for 400 ohms, 7 inches. If ⅜-inch tubing is used, D will be: for 200 ohms, 1 inch; for 300 ohms, 2.3 inches; for 400 ohms, 5.5 inches.

Coming back to our attempt to obtain maximum gain for channel 4, we now have the elements we need to stack two antennas. Length for each quarter-wave bar is 3.4 feet. As for spacing S between the antennas: at best they should be half a wave apart. The *free-air* half-wave spacing is 7.1 feet. However, the combined length of the two 3.4-foot quarter-wave sections is only 6.8 feet.

Since this discrepancy represents an error of less than 6 per-cent, reducing the spacing between antennas by this small amount to accommodate the size of the stubs will not produce any significant loss of efficiency. If every last drop of gain is considered important, each length of tubing in the stub can be made ¾ of a wavelength, and the stubs can be connected at an angle, as shown in Fig. 1A. If the small compromise is tolerable, however, two lengths of 6.8-foot tubing can be used between the two antennas and the antenna line can be connected at their midpoints.

When the signal from two antennas is still too weak, the obvious solution would be to add a third one. In actual practice, the use of three antennas is rare, but four can be matched conveniently and with good results. The most widely used method of stacking, and also the simplest, is shown in Fig. 3. Here we have doubled up on the two antennas shown in Fig. 1 and, as shown in the table of Fig. 3, the gain increase is again less than double. Where two antennas with half-wave spacing give 3.86 db, four antennas give 6 db. Again a reduction in spacing results in less gain.

The impedance matching problem is treated here in the same way as for the double stack. Consider first the impedance which should appear at the transmission-line terminals T_2 in Fig. 3. To get 300 ohms at this point, each set of matching stubs 3 and 4 must present 600 ohms; but we have shown in Fig. 1 that the impedance which is present at each set of terminal points

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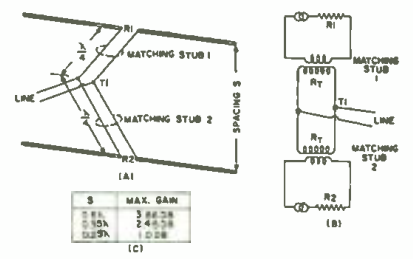


Fig. 1. Matching stubs (A) and antenna spacing are important in stacking. Equivalent electrical circuit (B) for two stacked units. Relationship (C) between gain of an array and antenna spacing.

Fig. 2. Critical values in matching stubs and formulas for deriving them.

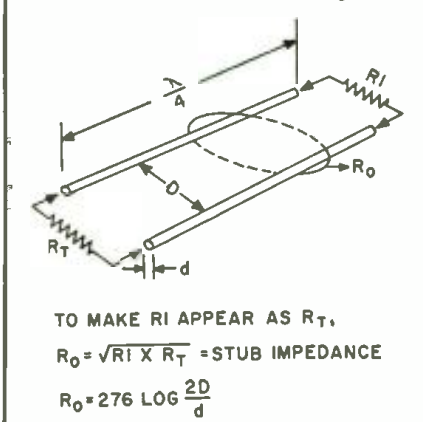
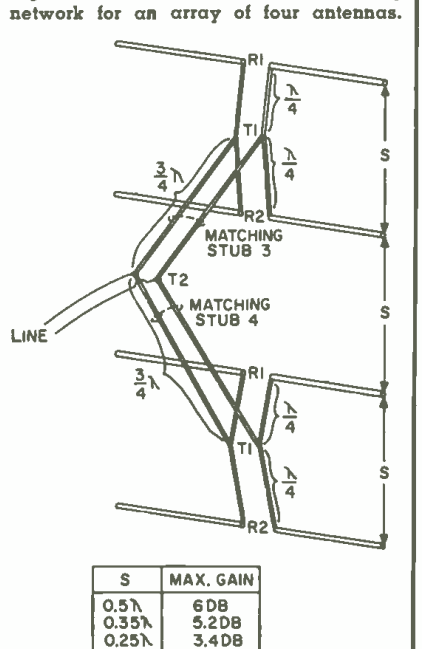


Fig. 3. Development of the matching network for an array of four antennas.



S	MAX. GAIN
0.5λ	6DB
0.35λ	5.2DB
0.25λ	3.4DB

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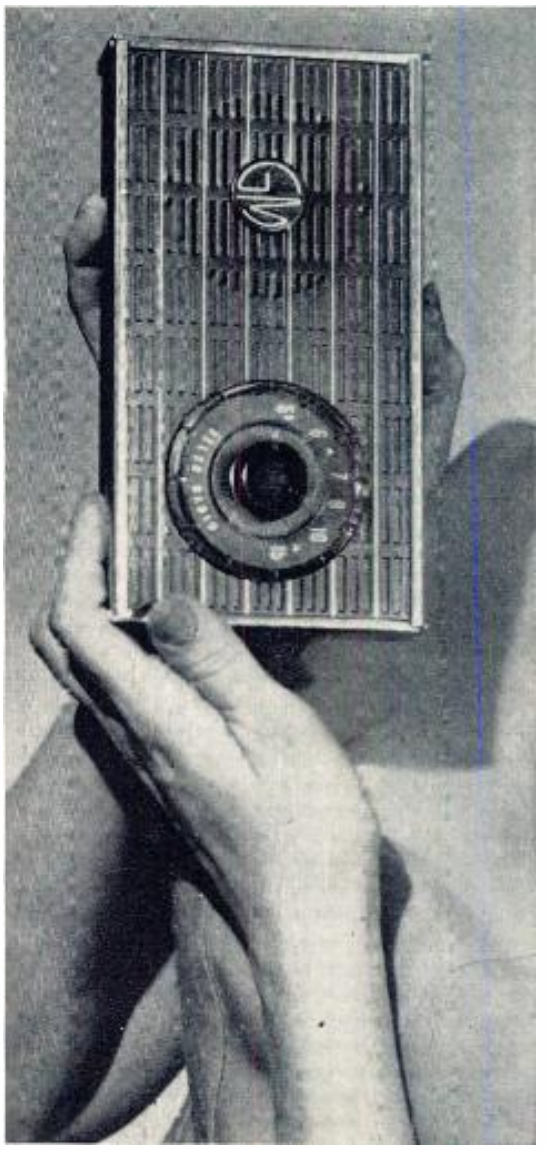
The All-Transistor Portable Car Radio: 1959

By **W. C. SAHM**
Delco Radio Div., General Motors Corp.

Two separate tuning systems make this unit more like a portable out of the car—and more like an auto radio in it.

Fig. 1. (left) In the car, the radio fits into the glove compartment, out of sight.

Fig. 2. (below) In the portable mode, this year's version is smaller than last year's.



WHAT'S new in automobile radios this year? The fully transistorized car receiver that may double as a compact portable has been around since the 1958 autos began rolling along the nation's highways. With some refinements, it is still the big news for 1959.

As evidence of its acceptance, the auto portable made by *Delco Radio* is being used in three of the *General Motors* lines. *Buick* has joined *Oldsmobile* and *Pontiac* in featuring it as an optional extra. Principal changes involve separate mechanical and electrical tuning arrangements for use in or out of the car. From this major shift, several advantages that did not exist a year ago accrue. (See *"Delco's* Portable Auto Radio," page 44, December, 1957.)

Since a permeability-tuning system is recognized as the preferred one for satisfactory auto-radio operation, the first versions of the auto portable were somewhat larger and heavier than this year's model to accommodate such a front end. With its separate, variable-capacitor tuning system, the new version makes the neat, streamlined package the young lady holds in Fig. 2. Helping to keep the receiver compact in its portable mode of operation is the fact that, like most transistorized portables, it does not include an r.f. stage. The latter, quite helpful for automotive use, is now consigned to the subchassis that remains in the car at all times, to be switched in and out automatically as needed. Shown at the lower left in Fig. 3, this r.f. stage is brought into play through the multicontact connector mounted to the rear of the receiver when the latter is slipped into place in the vehicle.

With the single tuning system used last year, in-car station selection was limited to the simple tuning dial of the

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portable. This would not be acceptable to many automobile owners who are accustomed to such features as illuminated, slide-rule dials of generous size and convenient push-button selection of favored stations. The 1959 model thus can provide five push-buttons along with a good-sized manual-tuning dial that remains in the car. A simpler tuning knob, driving the variable capacitor, is built into the portable body.

The independent tuning systems provide another convenience. There is no longer any need to have the portable still accessible when it is plugged into the car. For this reason, the 1959 model is placed in a rack inside the glove compartment (see Fig. 2) instead of fitting into a hole in the instrument panel, as was the case last year. With the glove compartment closed, the radio is out of sight altogether. With the glove compartment locked, the portable is safe.

A number of design changes have been made in the radio's circuits, as well as in its size and physical appearance. The portable itself is a six-transistor radio powered by four 1.5-volt mercury cells. When being used in the automobile, two more transistors—an r.f. amplifier and an audio power amplifier (lower right in Fig. 3)—are added to make an eight-transistor circuit.

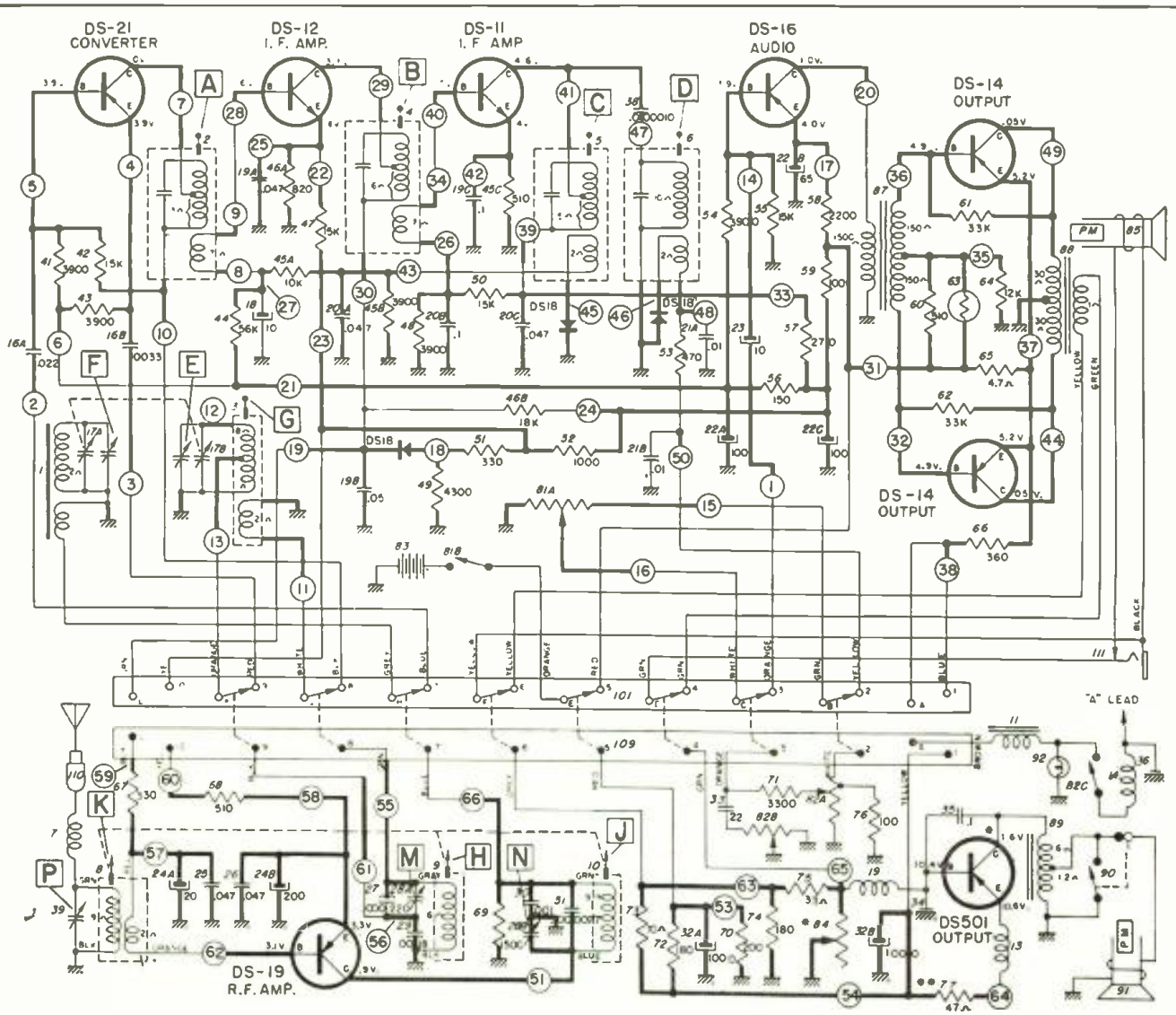
The six transistors in the portable mode provide the same power output as was obtained with *nine* transistors in the 1958 version. This reduction was made possible by eliminating the a.g.c. amplifier and using only an a.g.c. detector diode, by combining the functions of the oscillator and the mixer stages into one converter stage, and by placing the r.f. amplifier in the car, instead of in the portable.

As the portable is plugged into its rack in the glove compartment, the ten-contact female connector in the portable and the male connector in the rack meet to provide all of the necessary switching to change from portable operation to in-car operation. These connectors (the horizontal strips toward the bottom of Fig. 3) accomplish several jobs simultaneously. They disconnect the capacitively tuned oscillator and antenna circuits, the mercury-cell battery supply, the small portable speaker, and the portable volume control with its "on-off" switch. The push-button tuning unit in the car is only one of many features now provided. Power is supplied by the car battery. In place of the portable antenna, a slug-tuned automobile antenna circuit and the r.f. amplifier (DS-19) are used to provide a higher level of input signal to the converter stage. The converter circuit itself is also changed by the connector. The capacitively tuned oscillator circuit is replaced by a slug-tuned circuit. In order that the radio have sufficient power output for easy listening at highway speeds, the connector replaces the portable speaker with an added power amplifier (DS-501, following the push-pull amplifier), which gives the radio a maximum audio output of 6.5 watts, and which feeds a large oval speaker.

The result of these efforts by engineers of *Delco Radio* is a design that retains all of the features expected in a quality automobile receiver with no sacrifice of the advantages found in transistorized portables when the radio is used in that mode of operation.

—30—

Fig. 3. The 1959 version of the "double-life" Delco transistor radio. Circuits for in-auto use only are at the bottom.



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The "Inverted L" Ham Antenna

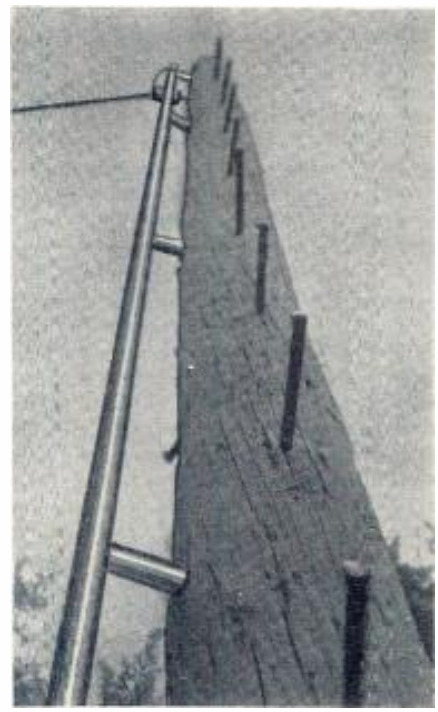
By **ROBERT M. SEE, W5LTD**

Construction of simple antenna and matching network that provides a good compromise in height, cost, and coverage.

AFTER moving into a new home it was hoped that a satisfactory solution could be found to the problem of installing an amateur antenna without detracting from the appearance of the neighborhood landscaping. This, of course, ruled out any type feedline which would hang suspended and flapping in the Oklahoma breeze. Naturally the buried coax feedline and all-band vertical came to mind. After considerable thought (this is always the hard part), it was decided to modify the vertical radiator to include some horizontal polarization. It was believed that this might increase the field strength, on 80 and 40 meters, over that of a vertical—at least within a 300-mile radius. In other words, we didn't want our signal to skip our local friends. As a consequence, the "Inverted L" antenna—which is a compromise in height, cost, and coverage—was adopted.

The utility pole was set 5 feet into the ground and has withstood 70 mph wind gusts without guy wires. It is located on the rear of a city lot, nestled in a group of eastern red cedar trees. It takes a sharp eye to detect any discontinuity in the landscape. The XYL believes this to be the best part of the entire installation, however, the author is partial to its operation and the strong signal reports received.

Fig. 1 shows the horizontal radiation patterns on the three bands for which the antenna was designed. It would be possible to operate the antenna on 15 and 10 meters with the proper matching networks but these bands have not been investigated.

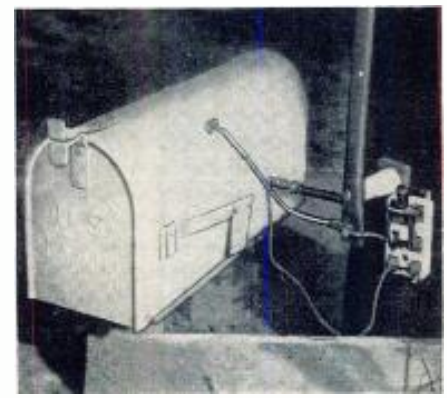


Vertical portion of antenna is made of copper water tubing, fastened by stand-off insulators. Matching network is inside rural mailbox at base of antenna. Adjustments are accessible through door and back of mailbox. Switch is for lightning protection.

Antenna Construction

The vertical portion of the antenna is made from a 32.5-foot section of ½-inch i.d. copper water tubing. It is mounted on 4-inch ceramic stand-off insulators which are, in turn, fastened to the telephone pole. The copper tubing can be purchased in coils of varying length and was used because it is easy to handle and workable. The horizontal portion of the antenna is 32.5 feet of #12 gauge stranded copper antenna wire. It is connected through an insulator to the top of the telephone pole for mechanical strength and then bonded to the top of the copper tubing. The other end is tied through an insulator to a tree some 40 feet away. The photographs show how the tubing is mounted on the pole and connected to the matching network.

The transmission line is buried about 6 inches in the sod and runs from the house to the base of the antenna where it enters the housing for the impedance matching networks.



The ground radials are made of four lengths of #12 gauge copper wire, 35 feet long. They stretch out in four directions from the base of the pole and are buried about six inches into the turf. They are securely bonded together at the pole to reduce losses and are connected to the matching network by a copper braid. In dry, sandy soil the radials should be made no less than 60 feet long and their number increased to six. It is imperative that the antenna have a good ground system, securely bonded to reduce losses.

The efficiency of this antenna on 80 meters is better than that of the 33-foot and 44-foot verticals because the high current (and high radiation) portion of the antenna has been raised.

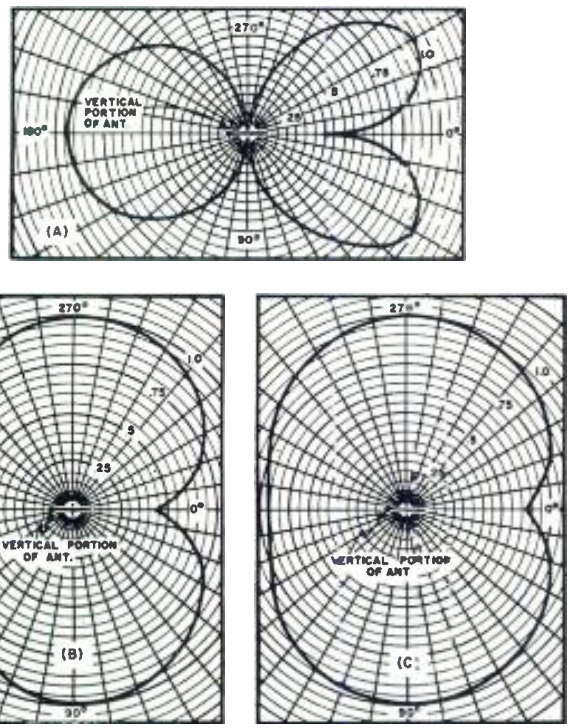


Fig. 1. The horizontal radiation patterns for the "Inverted L" amateur transmitting antenna are shown here on (A) the 20 meter, (B) the 40 meter, and (C) the 80 meter bands. Field strengths shown are all relative. It would be possible to operate the antenna on 15 and 10 meters with the proper matching networks but these bands have not been investigated as yet.

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Almost any length of wire or antenna configuration can be made to look like 50 ohms or any other transmission line impedance. This is the job of the impedance matching network. Since an r.f. bridge wasn't available, the impedance of the antenna was measured with a "Q" meter and a calibrated s.w.r. meter. The results are given here as a matter of information only: 14.2 mc., $Z = 650-j100$ ohms; 7.2 mc., $Z = 5000-j100$ ohms; 3.8 mc., $Z = 26 + j0$ ohms.

As can be seen from the circuit diagram of Fig. 2 and the photographs, bandswitching was handled by three separate switches. If the builder substitutes a ganged switch and a different parts layout, it is suggested that the coils be placed at right angles to each other to reduce mutual coupling.

All components were mounted on a plywood board which is slightly smaller than the inside dimensions of the RFD-type mailbox. The finished unit is slipped into the mailbox which provides excellent protection from the weather.

In the author's unit, C_2 was made up of a 50 $\mu\mu$fd. unit and a 30 $\mu\mu$fd. variable capacitor in parallel since the variable was on hand. The actual capacity needed is 70 $\mu\mu$fd. The 400 $\mu\mu$fd. mica capacitor used as part of C_3 should be of the high-current type. The one used here is a surplus *Sangamo* Type A2LH (2500 volts). The switches should also be able to withstand high current if high power is to be used because they will carry the full antenna current. The switches shown in the photographs were taken from an army surplus antenna tuning unit.

R_1 and RFC_1 were added to the circuit to bleed off any static charge which might develop during thunderstorms. The knife switch mounted on the utility pole is used to short the antenna and protect the station equipment when the station is not on the air during heavy electrical storms. This matching network has handled a 400-watt transmitter for a year and shows no signs of heating or arcing of components.

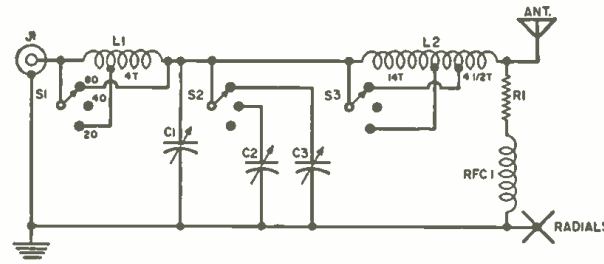


Fig. 2. Complete schematic diagram and parts list for the antenna matching unit.

R_1—10,000 ohm, 5 w. res.
C_1—100 $\mu\mu$fd., 1000 v. var. capacitor
C_2—70-100 $\mu\mu$fd., 1000 v. var. capacitor
C_3—500 $\mu\mu$fd. capacitor (400 $\mu\mu$fd. mica in parallel with 100 $\mu\mu$fd. var. unit)
L_1—6 t. #3905-1 B&W "Inductor," 2½" dia., tapped 4 t. from output end
L_2—22½ t. #3905-1 B&W "Inductor," tapped 4½ t. from ant. end and 14 t. from input end
J_1—Coax receptacle
RFC_1—2½ mhy. choke
S_1, S_2, S_3—Single-pole, 3-pos. low-loss switch (see text)

Calibration

As mentioned earlier, it is not necessary for anyone who plans to duplicate this antenna to do any design work to assure a good impedance match. It is necessary, though, to have a standing-wave indicator in the line while making the adjustments for low s.w.r. on each band. Start your adjustments with the switches set on the 20-meter band. While watching the s.w.r. indicator, rotate C_1 until the lowest reading is indicated. Small variables in the antenna installation may make it necessary to change the taps on the coils one or two turns. If this becomes necessary (it is if the s.w.r. indicator cannot be made to read a low value) the C_1 setting should be re-adjusted for a low reading after the taps are changed. When the s.w.r. has been made as low as possible on 20 meters the procedure is repeated on 40 and 80 meters while adjusting C_2 and C_3 respectively.

In addition to matching the 50-ohm line impedance to the antenna input resistance this network also corrects for reactance in the antenna and thereby affords easier loading to the transmitter. Fig. 3 shows how the s.w.r. varies over the band in the author's installation. As can be seen, the lowest s.w.r. was made to fall in the center of the band because both c.w. and phone operation were to be used. If the builder plans only c.w. *or* phone operation he may shift this low s.w.r. on 80 and 40 by making his adjustments on the frequency to be used.

In conclusion, it might be well to add that if you are the "bandhopping" type of operator, remember that you will have to visit the base of the antenna to switch bands. However, even this small obstacle can be looked upon as a "blessing" when you consider that in this age of automation most of us could use a little exercise!

Although this antenna cannot compete with a good beam, it has proved to be the answer to a serious problem at W5LTD. We have a sneaking suspicion that it will be in use for many years to come since it has provided excellent contacts all over the globe. We believe you will like it as well! -30-

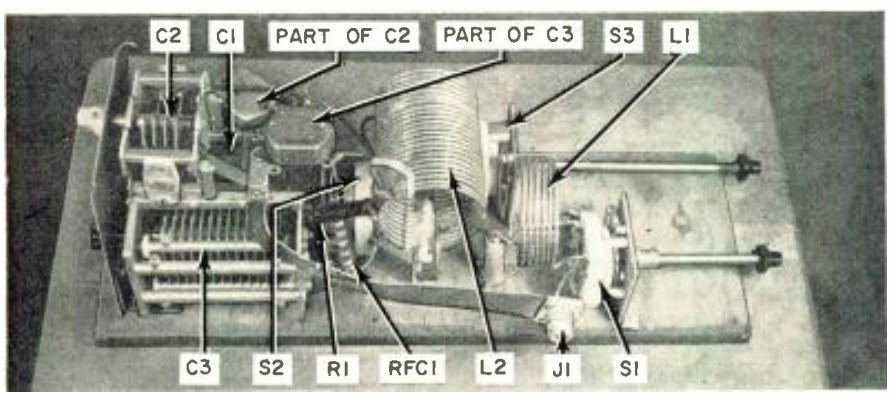
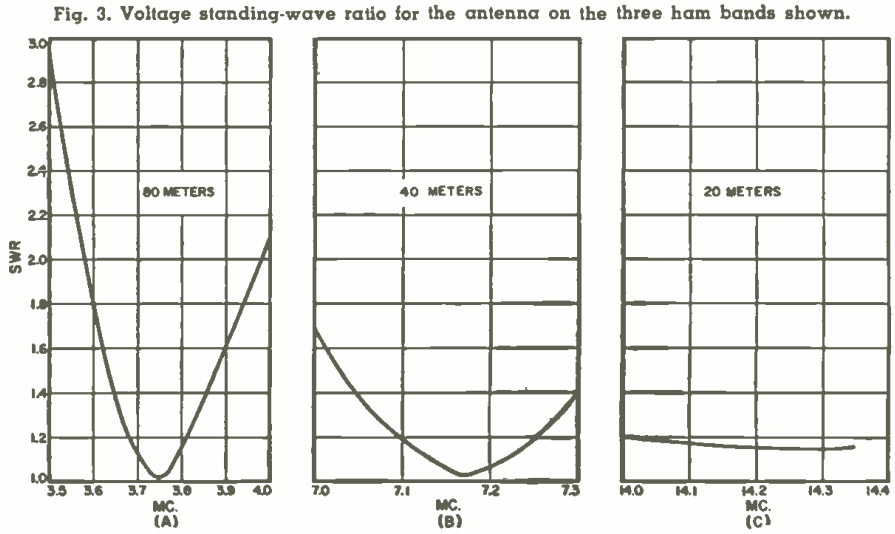


Photo showing the construction of the network, which is built on a plywood board.

Fig. 3. Voltage standing-wave ratio for the antenna on the three ham bands shown.



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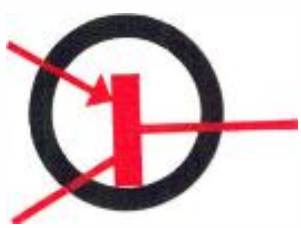
TRANSISTORS The Inside Story

Don't throw away those defective transistors. You'll learn a lot about them by looking inside their cases.

By EDWIN BOHR



OPENING the case of a transistor provides an educational experience that can not be duplicated in any other way. With the case open, a person can get a first-hand perspective of the actual emitter and collector dot size, the germanium wafer thickness, and the methods of assembly used by the manufacturer.

Of course, we can read about these things but reading lacks the visual impact and stimulation that are so effective in bringing about a quick understanding of transistor construction.

Obviously, transistors that have burned out are the ones to open and examine since they are no longer useful. However, the low cost of transistors now justifies opening even a new transistor. Fusion-alloy transistors sell for under a dollar and grown-junction types for as little as $1.50. These two transistor types, distinctively different in their manufacture, are representative of the bulk of present transistor production.

Except for a very limited production destined for consumption within the *Bell Telephone System*, the point-contact transistor is virtually "extinct." Another type, the surface-barrier transistor, is a fairly recent addition.

Even more sophisticated transistors —the tetrode and diffused-junction varieties—are now seeing use mainly in advanced electronic circuits for specialized applications where expense is no object. So, except for the surface-barrier transistor, let's forget about these latter types and talk about opening up some of the more interesting and available transistors.

Raytheon CK721, CK722

When one of these transistors is opened you may be in for a surprise. While early CK722 transistors were encapsulated in a plastic case that could be removed either by dissolving in solvent or heating and pulling off the case (careful, though, or the junction may be pulled out too), newer units are very different.

The metal case for the newer-type CK722 is really no more than a shell around the subminiature transistor inside. This inside transistor has a case like the 2N130A series of *Raytheon* transistors.

To take a CK722 apart, peel off the thin outside case with ordinary side cutters or needle-nose pliers. Beneath this cover lies a cement filler or coating that can be pushed off easily with the heated end of a gun-type soldering iron.

With the "gunk" removed, the inside transistor case is visible. This 2N130A-type case may be opened by heating the bottom of the shell with a soldering iron and simultaneously pulling gently with pliers. Fig. 1 is a cross-section view of the CK722 package.

Now that the cover is off, the complete transistor assembly can be seen. The germanium has a beautiful lustrous finish that is characteristic of etched germanium.

The emitter and collector dots are seen on either side of the germanium wafer. Somewhat more detail is visible with the aid of a magnifying glass. The larger dot forms the collector junction and the smaller one the emitter.

These emitter and collector dots are indium metal that, under heat, fuses into the *n*-type germanium forming regions of *p*-type germanium that are actually the emitter and collector. Germanium can be either *p* or *n* depending upon the type and relative concentrations of impurities. Arsenic added to the germanium makes it *n*-type and indium added to the *n*-type arsenic-doped germanium changes it to *p*-type.

All *Raytheon* transistors, including

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the silicon types, are made by this fusion process.

G-E 2N43, 2N107, 2N135

Like the CK722, these transistors are fused or alloy types but they are hermetically sealed in a welded housing. The germanium base is electrically attached to the case which acts as a heat sink. This type of construction gives the 2N43 a medium-power rating.

The welded hermetic case introduces no soldering fluxes or gasses that could possibly shorten the life of the transistor.

A cloudy jelly-like material, probably a glyptal type, coats the junction. It can be removed with a small brush.

Slight modifications of the dot size and base thickness produce different characteristics. In the 2N135, for example, the dots are made smaller and the *n*-type germanium thickness between the alloyed *p*-type layers is made thinner. All this results in superior high-frequency performance.

To open this transistor case, snip away the welded flange with cutters and the round cover lifts easily. Inside, the germanium wafer mounts on an angle bracket that is spot-welded to the header. Heavy lead strips connect the emitter and collector dots to the posts coming into the case through the glass seals.

Fig. 4 shows the general construction of *General Electric* diffused alloyed transistors.

G-E 2N78, 2N170

The 2N170 is a good example of an inexpensive grown-junction transistor. Grown- and fused-junction transistors are radically different.

Fused junctions are made by growing a large *n*-type crystal, cutting it into hundreds of wafers and then fusing *p*-type impurities into the germanium.

By another method the emitter, base, and collector can be produced within the crystal as it is grown. It can then be cut into hundreds of smaller slices each containing an *n-p-n* junction. These are known as grown junctions. Thus far the grown-junction transistors are made mainly with *n-p-n* junctions.

Using this method, the base thickness can be controlled to very close tolerances. For this reason, grown-junction transistors are particularly suited for high-frequency circuits. In fact, the first high-frequency junction transistors were *all* grown-junction types. However, alloy-junction transistors have now caught up to the grown-junction in this respect.

The grown-junction is already a transistor and it only remains to mount it in a suitable case. The ends of the junction-containing strip of germanium are attached to end tabs. These tabs are the collector and emitter connections.

Since the extremely thin base zone has no distinctive appearance, the base wire is moved along the germanium strip until an electrical measurement indicates the base has been found. The base lead is then welded in place.

General Electric transistors of this type have a characteristically tall rectangular case with rounded corners plus a seal-off tube and bottom-welded flange. The metal header, because of its upside-down dishpan construction, is extremely rigid.

There are quite a few small parts and tabs used in the construction of this transistor type. The germanium strip is secured to tabs extending from the collector and emitter support posts. A metal strip runs parallel to the germanium and allows the base lead to be welded any place along the entire length of the germanium. This is necessary because, in some transistors, the base region may be at an extreme end of the germanium strip.

Like the 2N107, this case is also opened by cutting around the bottom flange. The cover then lifts off easily without damaging the transistor. There is no "jelly" covering of the junction in this type. Fig. 3 shows the construction.

The transistor can be operated with the cover removed for a very effective demonstration. Too, experiments to show moisture contamination and photoelectric effects can be carried out with the cover removed. Fig. 2 shows a simple circuit for demonstrating the photoelectric effect on any exposed transistor junction. Be sure to use a negative collector voltage for *p-n-p* transistors and positive for the *n-p-n*.

Sylvania 2N34, 2N35

The 2N34 and 2N35, appearance-wise, are identical both inside and outside; however, the 2N34 is a *p-n-p* unit and the 2N35 is an *n-p-n* transistor. Most *n-p-n* units are grown-junction, but the 2N35 is an exception. It is a true alloy-junction transistor.

This results in similar characteristics for the two units except for the reversed polarity for bias and supply voltage. Consequently, a 2N34 and 2N35 pair is ideally suited for complementary symmetry circuits.

To open these transistors, unsolder the case at the bottom and pull off the cover. Fig. 5 illustrates the internal assembly.

Sylvania 2N68, 2N95, 2N101, 2N102

The 2N68 is more difficult to open. First, cut off the leads and chuck the case in a metal lathe. By cutting away the soldered seal and part of the aluminum cooling fins, the transistor assembly will drop out, together with a small amount of white powder. Presumably, this white powder is a dessicant.

The 2N68 transistor assembly is relatively large and easily observed. For that reason, the 2N68 insides give a very good display of diffused-junction transistor construction. Furthermore, the 2N68 geometry is pretty repre-

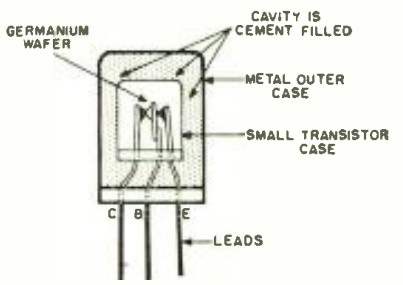
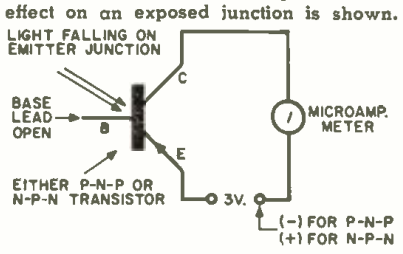
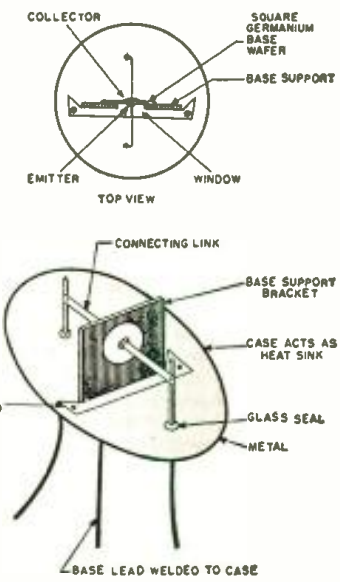


Fig. 1. Raytheon CK721, CK722 transistor.

Fig. 2. Demonstration of the photoelectric effect on an exposed junction is shown.





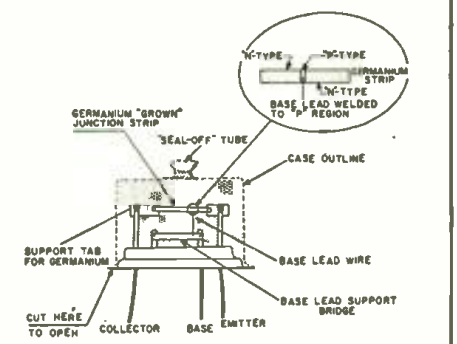


Fig. 3. Mounting for G-E rate-grown "n-p-n" transistors such as 2N78, 2N170, and others.

Fig. 4. General Electric's mounting for diffused-junction types 2N43, 2N107, 2N135.

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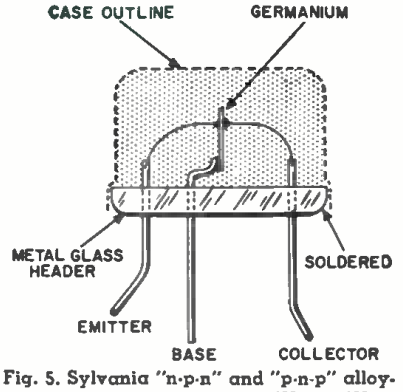


Fig. 5. Sylvania "n-p-n" and "p-n-p" alloy-junction transistors type 2N34, 2N35.

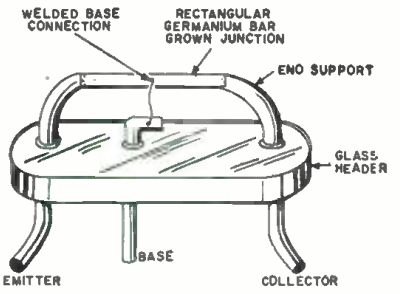


Fig. 7. Bell Labs grown-junction transistor.

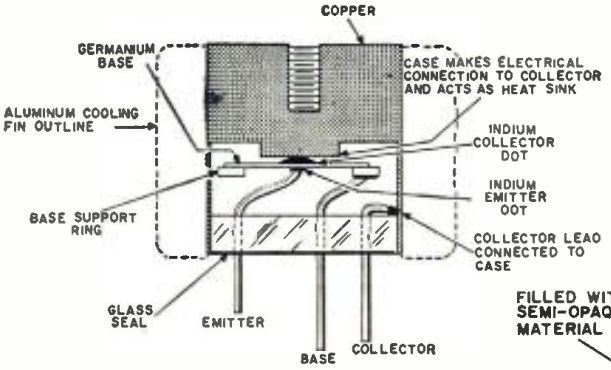


Fig. 6. The internal construction of the Sylvania transistor types 2N68, 2N101, etc.

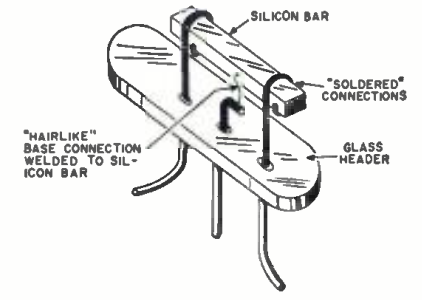


Fig. 8. Texas Instruments grown-junction silicon transistor TI 903, 904, 905, etc.

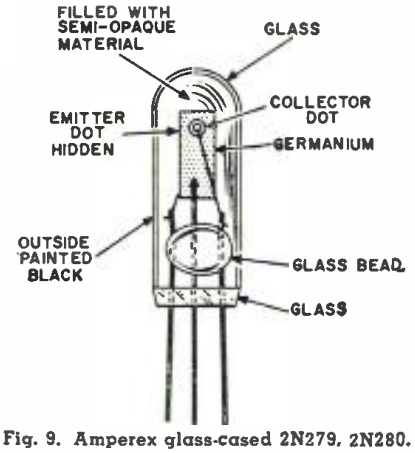


Fig. 9. Amperex glass-cased 2N279, 2N280.

sentative of all power transistors. See Fig. 6.

The base is a square of germanium, roughly the thickness of aluminum foil, made rigid and supported by a metal ring. This ring, in turn, mounts to the base lead coming through the header. The collector makes connection to the heavy copper case, which carries away heat from the junction.

Western Electric 2N27

This is a germanium grown-junction transistor with an interesting holder for the germanium bar. See Fig. 7. The supports at each end make a marvelously exact-fitted connection to the germanium. The base connection is a tiny wire welded to the base region. This type of base connection is characteristic of all grown-junction transistors.

The base connection, smaller than a fuse wire, usually is the part that burns out from an accidental short to the collector or some other high current input pulse. This base connection may be completely missing on some burned out grown-junction transistors.

Texas Instruments 903, 904

These are grown-junction silicon transistors. Internally, the construction is similar to the 2N27 just discussed, however, the silicon bar is soldered to the looped-around emitter and collector leads as shown in Fig. 8.

Silicon transistors are very expensive because of the extreme difficulties in processing the silicon. Silicon has a high melting point and must be heated in a crucible or pot fabricated of material having a melting point slightly higher than that of the silicon itself. Too, silicon is very active chemically and must be grown in an inert atmosphere. The difficulties in handling silicon are tremendous.

One company in the Boston area, where plenty of know-how about these things exists, worked about a year on its first silicon melt.

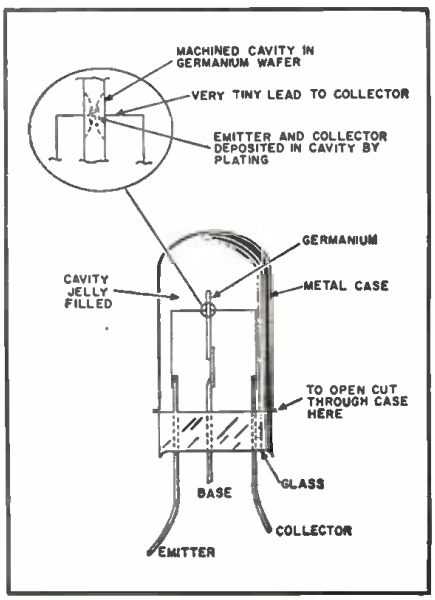
Amperex 2N279, 2N280

Amperex transistors are sealed in a tiny glass tube and look very much like a subminiature vacuum tube. The glass tube is painted black. To see the *p-n-p* fused junction inside, just scrape off the outside paint. See Fig. 9.

The cavity around the transistor junction is filled with an obscuring semi-opaque material; nevertheless, the junction is still visible.

This method of fabrication makes the *Amperex* transistor ideal for classroom demonstration. Anyone can look inside, yet the junction is still protected from moisture and handling by the glass hermetic case. Light falling on the junction has a photoelectric effect and this also makes the 2N279 very interesting in demonstrations.

Fig. 10. Philco surface-barrier SB-100.



Philco Surface-Barrier SB-100

While all the other transistors have contained two types of semiconducting material, produced during the crystal-growing or by fusion-alloy processes, the surface-barrier transistor contains only *n*-type germanium.

The emitter and collector are produced by plating indium metal onto the *surface* of the germanium. The thickness of germanium between emitter and collector is made very small by an electrolytic machining process that produces two dimples in the germanium.

Fig. 10 shows a cross-sectional view of this type of transistor. There are no emitter or collector dots; otherwise, it looks much like a fused-junction transistor.

If the transistor is opened and the protective jelly removed, two very tiny dimples with almost invisible lead wires running to them can be seen. The emitter and collector are plated in these dimples and the leads welded to them. The larger dimple, as seen with a magnifying glass, is the collector.

These emitter and collector leads, like the grown-junction base lead, are very easily burned out.

Don't throw away any defective transistors that come your way. Open them and look inside first. It is an educational experience that can not be duplicated by any amount of reading or peering at diagrams! -30-

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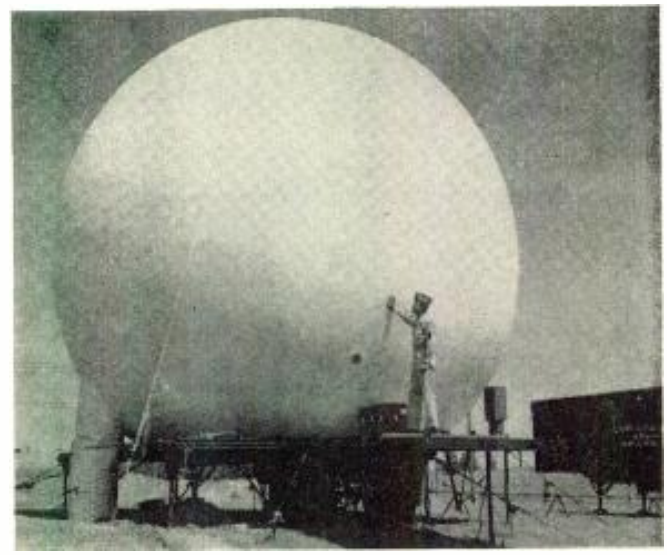
New Frequency Scanning Radar

Large mobile unit uses single antenna for distance, bearing, and altitude data.



Plastic balloon, resting on mobile trailer bed, protects antenna.

Scope at extreme left shows range and bearing data, while other display shows altitude. At right, entire indicator console has been pulled out on rollers to provide easy servicing.

A NEW frequency scanning radar which detects airborne targets at extreme range and for the first time simultaneously computes distance, bearing, and altitude, was unveiled by the Army. Called "Frescanar," the radar which was developed by *Hughes Aircraft Co.* is the eyes of the "Missile Monitor," an Army air defense guided missile fire distribution system for mobile use with a field army. The entire system consists of one equipment van, one power truck, and one antenna trailer. The equipment van houses all radar gear except the antenna.

In principle, a frequency scanning radar is one that is able to cause the searching radar beam to be moved rapidly without actually moving the antenna physically. This is done by applying a succession of frequencies to a special antenna whose directivity is made sensitive to the applied frequency. By changing the frequencies at electronic speeds, the radar beam is caused to move far more rapidly than is possible by actual physical movement of the antenna. This beam is then able to monitor numerous high-speed aerial targets at many altitudes and bearings.

The special antenna is protected from the wind and weather by a radome of fabricated rubberized nylon—vulcanized to two layers of neoprene-coated fabric—weighing about 600 pounds. The radome is inflated by two air blowers and kept that way by slight pressure from one blower.

Five basic advantages claimed for the new radar system over conventional radars are:

1. Range performance. "Frescanar" concentrates all available power in sharp pencil beams of energy flashing on and off in a fan-shaped array to pinpoint targets at great distance with extreme accuracy.

2. Single antenna and operator. Conventional systems need two or more radars, operators, and master consoles to achieve similar results. The new radar needs only one of each, sharply reducing weight, bulk, and personnel to make transportation with other Army field units easier. Use of transistors further cuts size and increases ruggedness for movement.

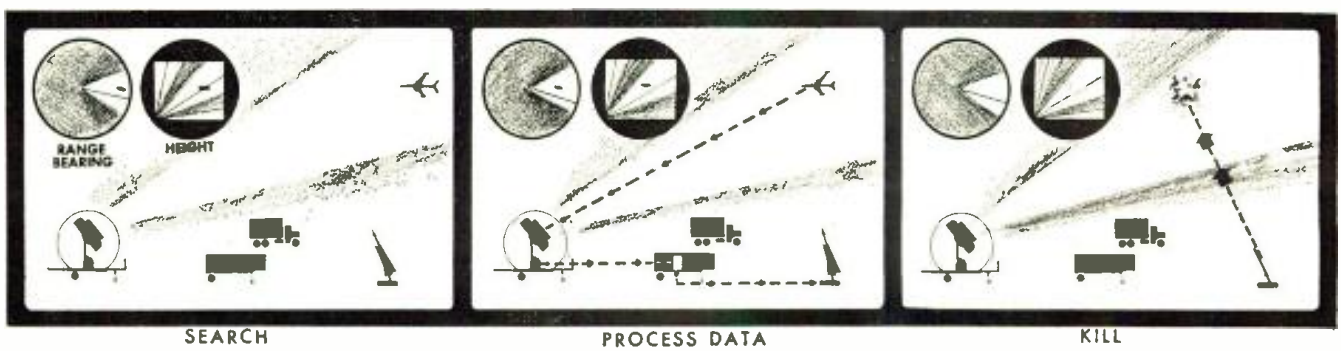
3. Triple function. The frequency scanning radar computes range, bearing, and altitude at the same time.

4. Greater speed. All three types of data—range, bearing, and altitude—are transmitted to missile batteries, helping them to direct missiles on targets much more rapidly.

5. Sees more targets clearer. The electronic beam scans rapidly and greatly increases the number of targets which can be tracked at the same time, provides better separation of closely spaced targets with minimum of ground clutter, and pinpoints targets faster.

All the units in the over-all fire control system are interconnected and can communicate with each other even with part of the system destroyed or inoperative. Thus a fragmented system could still operate. -30-

Target is first detected, the data is processed to missile batteries, which are then fired automatically.



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Problems in Horizontal Blanking

By JESSE DINES
Author of "Servicing TV Sync Systems"

Blanking networks, increasingly used, prevent many retrace faults. Learn about these circuits. Add them where needed.

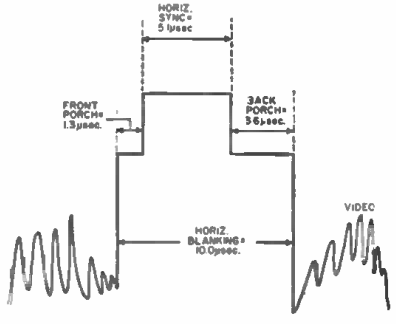
WITHOUT much fanfare, there has been a trend toward incorporation of circuits to remove horizontal retrace lines in TV receivers. Their widespread use in color sets is not hard to understand. However, suppression of the horizontal return trace in monochrome sets was virtually non-existent until recent years. One may wonder why this is so at a time when features of marginal value are being dropped by receiver designers. What troubles, for example, might result if the return trace is not suppressed? Fig. 1 shows two of the difficulties which are possible when, for one reason or another, there is electron-beam conduction in the picture tube during the brief interval of the return trace.

In Fig. 1A, horizontal foldover exists at the left side of the picture and extends over to the extreme right. This particular defect results when the retrace time of the saw-tooth current flowing through the horizontal yoke windings is too slow. In Fig. 1B, a faint, vertical white line appears at the left of the picture. (The fine tuning control was adjusted to accentuate the symptom.) This particular defect was caused by a fault in the horizontal sweep circuit. If the steep, downward slope of the horizontal-sweep sawtooth (the portion representing the return trace) has its shape severely distorted by any defect, such a band may be the result.

Sometimes a bright vertical line or band that is "wavy" appears in the raster at certain times, as when station breaks occur. Excessive retrace time or radiation from the sweep circuit during this period can cause such abnormal picture symptoms. This article explains the reasons for these abnormalities, as well as how to eliminate them.

Fig. 1. Foldover (A, above) and light bars (B, below) may be retrace problems.

Fig. 2. Portion of composite video signal, showing horizontal pulse area.



Horizontal Foldover

To understand what causes foldover due to slow retrace time, examine the horizontal sync and blanking portion of the composite video signal (Fig. 2). Note that the front porch (1.3 microseconds) is narrower than the back porch (3.6 μsec.). This is done to give the retrace more time to end before total blanking time (10 μsec.) ends. This is shown more specifically in Fig. 3 which indicates (A) the composite video signal, (B) horizontal sweep voltage showing trace and retrace portions, and (C) a portion of the raster which is scanned. Proportions have been distorted to highlight certain details at the raster edges.

Consider the normal circumstances first. A raster line is scanned from point 1 to point 4 (beginning of the horizontal sync pulse as shown in Fig. 3B). The time from points 1-2 and 3-4 are blanked out, since horizontal blanking takes place at this time. The raster line produced is shown in Fig. 3C. Retrace begins at point 4 and ends at point 5 which corresponds to point 1, the beginning of trace, for the next scanned line.

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As long as the retrace ends before blanking time ends (point X in Fig. 3A), the retrace line will not extend into the video portion of the composite video signal. If the retrace does extend beyond point X, some of the video will be "retraced" and horizontal foldover will occur at the left side of the picture.

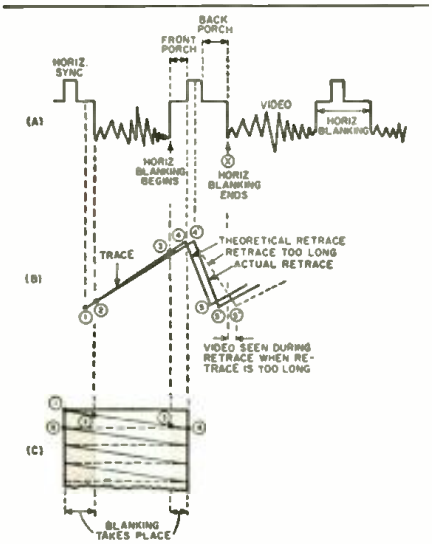
The combined duration of the sync pulse plus the duration of the back porch (refer back to Fig. 2) is equal to 5.1 + 3.6 or 8.7 μsec. This means that, in order *not* to have foldover, receiver retrace time should certainly be no greater than this 8.7-μsec. interval. Actually, it is better to make this period *shorter* than 8.7 μsec. because retrace usually begins at point 4′ (in Fig. 3) and not at point 4. This results from the inherent delay of the sync pulses through r.f., i.f., and particularly the sync-separator circuits of the receiver before the pulses can trigger the horizontal oscillator.

In Fig. 3B, if retrace starts at point 4′ it ends at point 5′ which, although slightly beyond point 5, is still within acceptable limits to prevent foldover. However, if the retrace interval is too great, retrace will terminate at point 5″ and foldover will occur.

Reducing Flyback Time

In receivers without blanking circuits, problems like the one just discussed can often be handled by shortening the flyback period. The retrace time depends on inherent operation of the horizontal sweep (flyback) circuit. Although it is beyond the scope of this article to discuss flyback circuit operation, certain facts will help us understand how retrace is produced. Fig. 4 shows three pertinent waveforms of the flyback circuit. Waveform (A) is the signal fed to the horizontal output tube grid. At point "A," the tube is cut off and the flyback circuit goes into self-oscillation. The oscillatory tank circuit is formed primarily by the inductances and distributed stray capacitances of the flyback transformer, horizontal yoke windings, width coil, and all of their connecting leads.

Fig. 3. Relationship between video being scanned, scanning time including retrace period, and raster display.



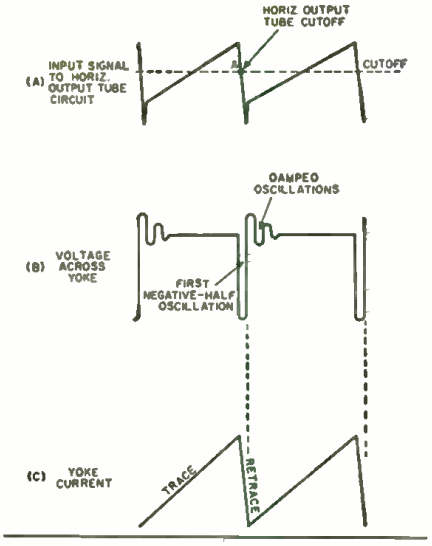


Fig. 4. Key horizontal-sweep waveforms.

The oscillations are damped as indicated by the yoke voltage waveform shown in Fig. 4B. The period of the first negative-half oscillation determines the retrace current through the yoke. See the yoke current waveform shown in Fig. 4C. Thus, the higher the frequency, the shorter the period and the quicker the retrace; conversely, the lower the frequency, the longer the retrace period. Since we want the shortest possible retrace time, the inherent resonant frequency of the flyback circuit must be as high as possible.

A frequency of 70 kc. or higher (even as high as 90 kc.) is necessary to produce the correct retrace time. At a frequency of 70 kc., the period of one-half cycle for retrace is ½ x $1/(70 \times 10^3)$ or approximately 7 μsec. At 90 kc., the retrace time is only 5.5 μsec., which is still better.

How can we keep the resonant frequency of the flyback circuit as high as possible in order to keep the retrace period as short as possible? The answer is by reducing the stray capacitance of the circuit since frequency and capacity are inversely proportional. This, in turn, can be done by keeping the horizontal output tube and high-voltage rectifier plate leads, and other such leads, as far away as possible from the high-voltage cage or other ground points.

A yoke or flyback transformer that has lost some of its efficiency through the accumulation of moisture in its windings must be replaced since the moisture increases the distributed capacitance across the windings. Substituting the output, damper, and/or high-voltage rectifier tubes may decrease retrace time, if the latter is marginal.

In some flyback circuits there is a capacitor connected across two taps of the flyback transformer secondary, frequently across the width coil. Although it serves to increase picture width, it may also increase retrace time. If this capacitor is removed to reduce the flyback interval and too much width loss results, other means can often be employed to restore this loss. These schemes include: decreasing the value of the horizontal-output tube screen-grid resistor, increasing the horizontal drive voltage by re-adjusting the drive control, and/or re-adjusting the width coil.

If such methods fail to remove foldover due to excessive retrace, then a retrace elimination circuit must be employed. Such circuits will be discussed later. Of course, the use of these circuits will also remove that portion of the video information that is folded over on the left side of the picture. However, this loss is not serious since it represents only a very small portion of the entire video signal.

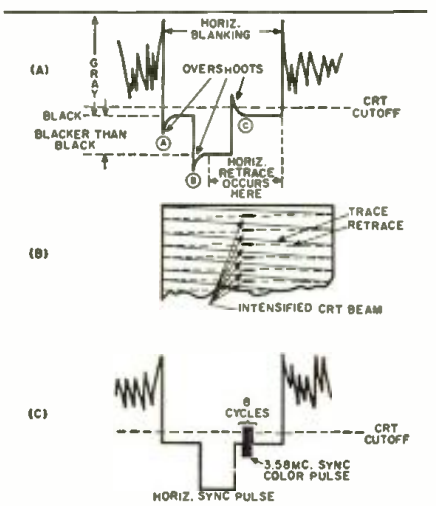
Vertical Line Distortion

Some video amplifiers are designed to "overpeak" signal before feeding this information to the picture tube. Although this tends to sharpen picture quality, it sometimes causes overshooting of the sync and blanking pulses as shown in Fig. 5A. Overshoots "A" and "B" are in the area of picture tube cut-off; thus they have no effect on the tube's beam current. Overshoot "C" extends into the conduction area (gray region of the composite video signal), resulting in picture-tube conduction where cut-off should normally take place.

The effect on the raster is shown in Fig. 5B, where the picture-tube electron beam is momentarily turned on every time it passes near the center of the screen, since overshoot "C" occurs at about the center of horizontal retrace time. The result is a fuzzy rope-like vertical line. To remove this line, a retrace elimination circuit should be used; otherwise, it may be necessary to redesign the video amplifier peaking circuits to remove the overshoot.

Radiation (or spray) from the horizontal sweep circuit into the video cir-

Fig. 5. White, vertical raster lines can be caused by overpeaking of pulses (A, B) or by the color-sync burst (C).



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cuits of the receiver can also cause a distorted sync pulse similar to the one shown in Fig. 5A. The same abnormal picture results as for overshoot. If the radiation from the horizontal sweep circuit cannot be removed by shielding or damping the circuit, a retrace elimination circuit should provide results.

In color sets, the 3.58 mc. color sync signal, which appears on the back porch of the horizontal blanking pulse, can also cause one or several vertical lines in the picture when the cut-off level of the picture tube is too close to the sync pulse. This is shown in Fig. 5C.

Elimination Circuits

Fig. 6 shows some horizontal-retrace elimination circuits used in TV sets. The voltage appearing at the output-tube grid in Fig. 6A (*Motorola* TS-525) is fed to the picture-tube control grid through an *RC* network. In Fig. 6B (*RCA* CTC5), a tap on the flyback transformer secondary connects to the first anode of the 21AXP22 color picture tube through a capacitor-divider network. In Fig. 6C (*G-E* 21T7), a separate horizontal blanking tube is used to supply positive blanking pulses to the 21EP4B cathode. The blanking tube, one half of a 12AX7, is a cathode follower whose input comes from the width coil. Note that vertical blanking pulses also feed in at the 12AX7 cathode for the purpose of removing vertical retrace lines.

Another blanking circuit that uses a cathode follower—one half of a 6BL7—is shown in Fig. 6D (*G-E* 15CL100). Its input to the grid comes from a tap on the flyback transformer secondary; its output, taken from the cathode, feeds the three cathodes of the color picture tube. Note that a similar blanking circuit—one half of a 12BH7—is used to feed vertical blanking pulses to the picture-tube cathodes, which results in the composite blanking signal at the junction of R_{472} and R_{474}.

Adding a Blanking Circuit

Any of the retrace elimination circuits just discussed may be incorporated in various receivers. However, one very simple type that can be used is shown in Fig. 7. The high side of the horizontal yoke windings is connected to the picture tube's first anode (or screen grid). The yoke supplies this electrode with a negative-going blanking pulse. It also supplies the first anode with "B+" voltage.

To install the network, remove the yoke balancing capacitor, *C*, which connects across the high side of the horizontal coils. This capacitor is usually 47, 56, or 100 $\mu\mu$fd. In its place, a piece of insulated, shielded cable is used, the distributed capacitance of which serves as the balancing capacitor. The exact length of cable used depends on the value of *C* desired. A wire about 8 to 12 inches long should be suitable. Try different lengths experimentally for best results as indicated by observation of the left-hand side of the raster. (A piece of 75-, 150-, or 300-ohm transmission line can also be used for this purpose but its length should run a foot or more.)

Disconnect the wire that supplied "B+" or boost voltage to the first anode of the picture tube and tape the open end properly with high-voltage tape. Connect the insulated shielded cable, as shown in Fig. 7. The center conductor connects to the high side of the yoke—usually the blue lead or pin number 3. The shielded end of the cable is connected to the center tap of the horizontal coils.

Tape the cable against the neck of the picture tube to hold it in place. Do not ground the shielded end since the cable must be connected in the circuit in exactly the same way as was balancing capacitor *C*. If this is not done, yoke ringing will occur. This results in several vertical lines appearing at the left side of the raster which gradually diminish in intensity as they approach the center.

In some yokes, balance is achieved without a capacitor. These include units in which both horizontal windings are connected in parallel or their center tap connects to a tap on the flyback transformer. In these cases, the method just described for introducing blanking generally cannot be recommended: the capacitance of the added length of wire might actually cause imbalance and disturb the left side of the raster. Instead, separate pickup coils, as shown in Fig. 8, can be used to obtain the blanking pulse.

Fortunately, such coils are commercially available. *RCA*, for example, has put them on the market. Whether the pulse induced in these added windings should be applied to the grid or cathode circuit of the picture tube may be determined experimentally by trying out both connections, reversing polarity of the leads in each case, and thus determining which connection provides the best results. Generally connection should be made to the CRT cathode if video signal is fed to the grid, and connection is best made at the grid if video is applied to the cathode. Detailed instructions for installing the coils are supplied by the manufacturer. —30—

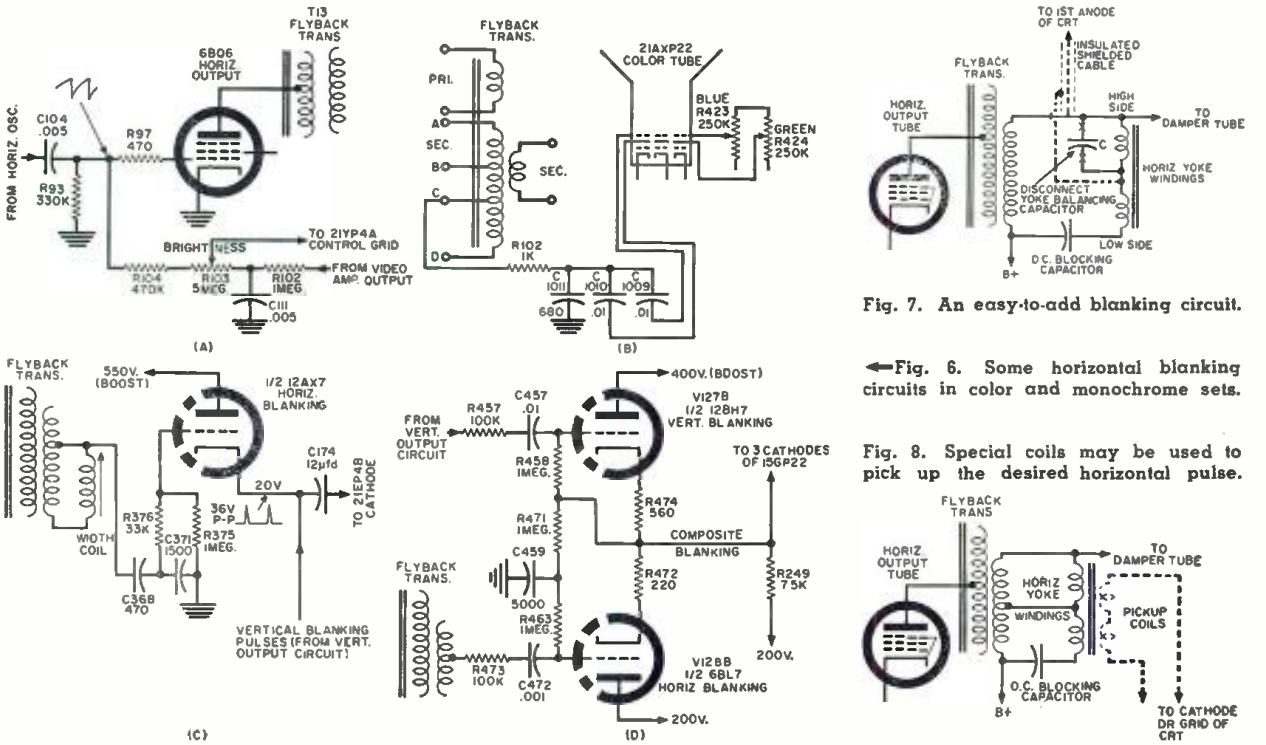

Fig. 7. An easy-to-add blanking circuit.

←Fig. 6. Some horizontal blanking circuits in color and monochrome sets.

Fig. 8. Special coils may be used to pick up the desired horizontal pulse.

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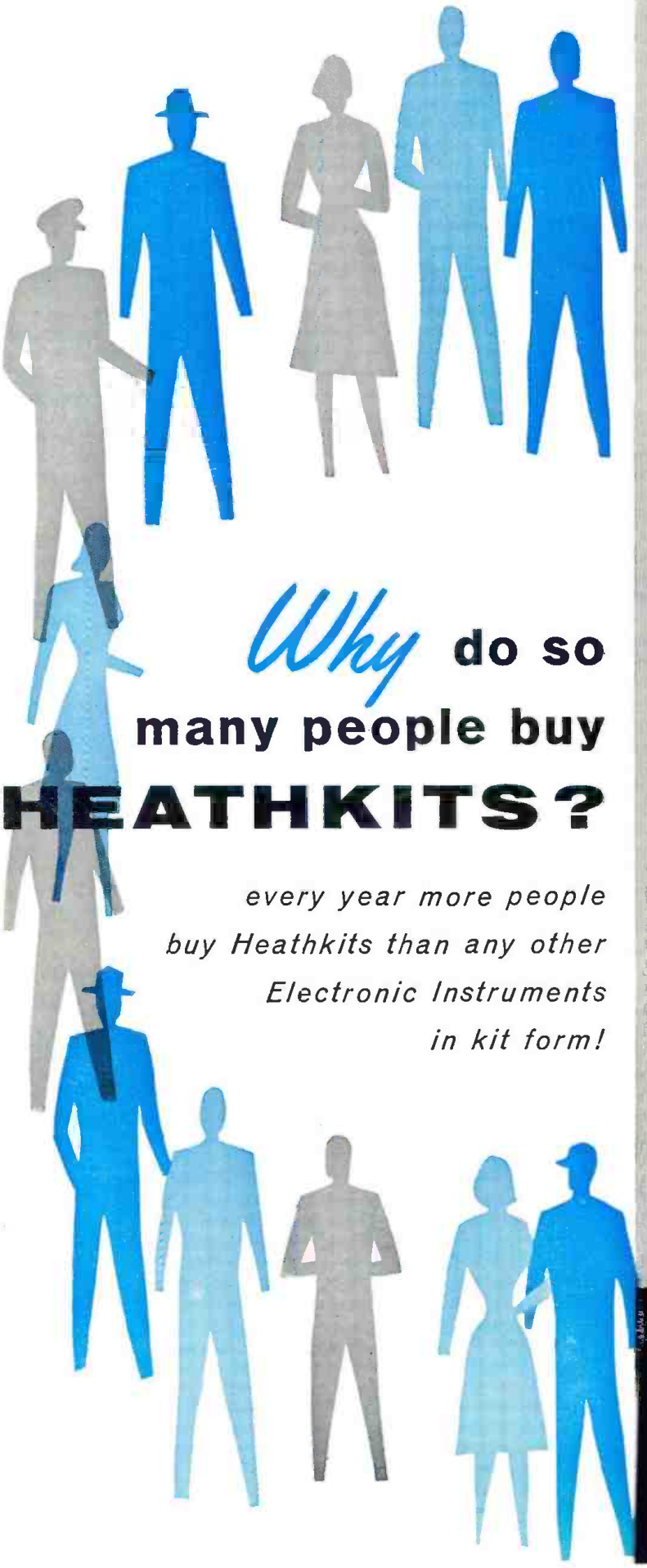

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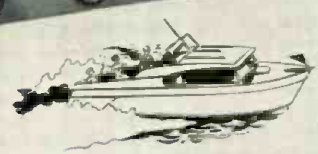

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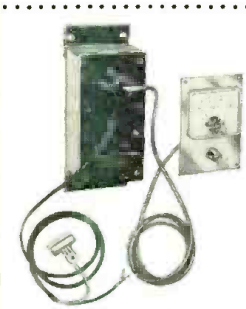

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PROFESSIONAL OSCILLOSCOPE KIT

Everything you could possibly want in an oscilloscope is found in the new Heathkit model OP-1. Featured are DC coupled amplifiers and also DC coupled CR 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 waveform 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 50 cycle rate, but can be driven over a wide range of frequencies with no additional adjustment. Prewired terminal boards are used for rapid, easy assembly of all critical circuits. Power supply is transformer operated utilizing silicon diode rectifiers and is fused for protection. Handsome cabinet features silver anodized front panel with red and black lettering and matching knobs. Shpg. Wt. 34 lbs.

HEATHKIT MODEL OP-1 $179.95

VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

Invaluable in experimental and design work, the PS-4 eliminates the need for building up a separate power supply for each new circuit tried. It provides a convenient source of variable regulated B+, variable bias voltage and filament voltage for labs and work shops. The PS-4 supplies regulated B+ output continuously variable from 0 to 400 volts DC at up to 100 ma, bias voltage variable from 0 to —100 volts DC at 1 ma, and filament voltage of 6.3 volts AC at 4 amps. Separate panel meters continuously monitors voltage and current output. Rugged, top-rated components used throughout for long, reliable service. Shpg. Wt. 16 lbs.

HEATHKIT MODEL PS-4 $54.95

Your best dollar value...

HEATHKIT

HEATH COMPANY • Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.

TEST OSCILLATOR KIT

Provides the test frequencies most often used by servicemen in repairing and aligning modern broadcast receivers. Five fixed-tuned frequencies (262 kc, 455 kc, 465 kc, 600 kc and 1400 kc) are quickly selected for troubleshooting or alignment of the IF frequency and high and low end of the broadcast band for proper tracking. Shpg. Wt. 4 lbs.

HEATHKIT MODEL TO-1 $16.95

HEATHKIT MODEL O-12 $65.95

"EXTRA DUTY" 5" OSCILLOSCOPE KIT

Laboratory quality at utility scope price makes this instrument an unusual value. The Heath patented sweep circuit functions from 10 CPS to better than 500 kc in five steps, giving you five times the usual sweep obtained in other scopes. Vertical frequency response extends from 3 CPS to 5 mc +1.5 db —5 db without extra switching. An automatic sync circuit with self-limiting cathode follower provides excellent linearity and lock-in characteristics. Extremely short retrace time and efficient blanking action are characteristic of this scope. 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 etched metal circuit boards and precut, cabled wiring harness. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. An ideal scope for all service applications as well as in standard or color TV servicing. Shpg. Wt. 22 lbs.

MODEL SG-8 $19.50

RF SIGNAL GENERATOR KIT

A "must" for any beginning serviceman, this indispensable instrument is used for aligning tuned circuits quickly and tracing signals in faulty RF, IF and audio circuits. Covers 160 kc to 110 mc on fundamentals in five bands and from 110 mc to 220 mc on calibrated harmonics. Coils are prewound and calibrated. Complete with output cable and instructions. Shpg. Wt. 8 lbs.

MODEL AG-9A $34.50

AUDIO SIGNAL GENERATOR KIT

This unique generator uses three rotary switches to select two significant figures and a multiplier to determine audio frequency, allowing return to the exact frequency previously measured when making multiple frequency measurements. Covers 10 CPS to 120 kc with less than .1 of 1% distortion between 20 and 20,000 CPS. Shpg. Wt. 10 lbs.

MODEL TS-4A $49.50

TV ALIGNMENT GENERATOR KIT

TV service technicians will appreciate the outstanding features found in this sweep generator. Provides essential facilities for aligning FM, monochrome TV or color TV sets. The all-electronic sweep circuit employs a trouble-free controllable inductor which varies frequency by magnetic means. An unusual buy at this low price. Shpg. Wt. 16 lbs.

MODEL CD-1 $59.95

COLOR BAR AND DOT GENERATOR

The CD-1 combines the two basic color servicing instruments, a color bar and white dot generator in one versatile and portable unit, which has crystal controlled accuracy and stability for steady lock-in patterns. (Requires no external sync leads.) Easy-to-build and easy-to-use. No other generator on the market offers so many features at such a great price saving. Shpg. Wt. 13 lbs.

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ETCHED CIRCUIT VTVM KIT

Time proven for dependability, accuracy and overall quality, the V7-A is one of the wisest investments you can make for your electronic workshop or lab. Its multitude of uses will make it one of the most often used instruments in your possession. Use it to measure all operating voltages and potentials such as B+ and AC-DC, or straight AC power supplies, filament voltage, bias voltage, AVC voltage, line voltage, etc. Ideal for measurements in all types of AM, FM and TV circuits. Checks discriminator or detector operation, AVC or AGC performance, while the ohmmeter may be used to measure circuit continuity, circuit resistance, to test out individual components with resistance measurement, or to trace circuit wiring through cables or chassis openings. Front panel controls consist of rotary function switch and a rotary range selector switch, zero-adjust and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuit for high accuracy and an etched circuit board is employed for most of the circuitry. The circuit board not only simplifies assembly but permits levels of circuit stability not possible with ordinary conventional wiring methods. Shpg. Wt. 7 lbs.

HEATHKIT MODEL V7-A **$25.95**

HEATHKIT MODEL M-1 **$17.95**

HANDITESTER KIT

Ideal for use in portable applications when making tests away from the work bench or as an "extra" meter in the service shop. The combination function range switch simplifies operation. Measures AC or DC voltage from 0 to 10, 30, 300, 1,000 and 5,000 volts. Direct current ranges are 0 to 10 ma and 0 to 100 ma. Ohmmeter ranges are 0 to 3,000 and 0 to 300,000. Top quality, precision components used throughout. Small and compact, take it with you wherever you go. Very popular with home experimenters and electricians. Test leads and 1½ volt size C battery are included with the kit. Shpg. Wt. 3 lbs.

HEATHKIT MODEL MM-1 **$29.95**

20,000 OHMS/VOLT VOM KIT

Portable and accurate, this kit features a 50 ua 4½" meter and 1% precision multiplier resistors for high accuracy. No external power required. Provides a total of 25 meter ranges on a two-color scale. 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, 1,500 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. Housed in an attractive bakelite case with plastic carrying handle. Batteries and test leads included. Shpg. Wt. 6 lbs.

TUBE CHECKER KIT

Brand new in every respect, the TC-3 features outstanding performance and ease of operation. Sockets are provided for 4-pin, 5-pin, 6-pin, 7-pin, large, 7-pin miniature, 7-pin sub-miniature, octal, loctal, and 9-pin miniature tubes. Protection against obsolescence is provided by a blank socket to facilitate modification for checking newly added tube types. A 10-lever switch makes it possible to connect any element to any other element regardless of the pin numbers involved. A neon bulb indicator shows filament circuit continuity and leakage or shorts between elements. A specially designed spring loaded roll chart mechanism permits the roll chart to run freely throughout its entire length without binding. Thumb wheel drive knobs are provided on both sides of the panel to accommodate the left handed operator. Compact and small in size, the TC-3 is ideally suited for portable applications. Both the roll chart and the meter are illuminated to facilitate use in darkened areas. Shpg. Wt. 12 lbs.

HEATHKIT MODEL TC-3 **$39.95**

MODEL AV-3 **$29.95**

AUDIO VTVM KIT

This vacuum tube volt meter emphasizes stability, broad frequency response and sensitivity for accurate measurement of critical AC voltages. Features a large 4½" 200 ua meter with increased damping in the meter circuit for stability in low frequency tests. Measures AC from a low value of 1 millivolt to a maximum of 300 volts AC (RMS). Voltage ranges are: 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover −52 to +52 db. 1% precision multiplier resistors used for maximum accuracy. Frequency response is essentially flat from 10 CPS to 200 kc. Shpg. Wt. 6 lbs.

MODEL CT-1 **$7.95**

IN-CIRCUIT CAPACI-TESTER KIT

This handy kit checks capacitors for "open" or "short" right in the circuit. Detects open capacitors from about 50 mmf, not shunted by an excessive low resistance value. Checks shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). Checks all bypass, blocking and coupling capacitors of the paper, mica or ceramic types. (Does not detect leakage nor check electrolytic condensers.) Electron beam "eye" tube is used for quick indication. A 5-position function switch is featured which controls the power to the instrument and selects the test being made. Easy to build and easy to use. Test leads included Shpg. Wt. 5 lbs.

MODEL BE-5 **$39.95**

LOW RIPPLE BATTERY ELIMINATOR KIT

Completely up to date the BE-5 will power all the newest transistor circuits requiring 0 to 12 volts DC, and the new hybrid automobile radios using both transistors and vacuum tubes. An extra low-ripple filter circuit is employed holding AC ripple down to less than .3%. Doubles as a battery charger or marine converter. Shpg. Wt. 21 lbs.

MODEL T-4 **$19.95**

VISUAL-AURAL SIGNAL TRACER KIT

New in every respect the T-4 features a built-in speaker and electron beam "eye" tube for signal indication, and a unique noise locator circuit. Ideal for use in AM, FM and TV circuit investigation. Transformer operated for safety and high efficiency. Complete with test leads and informative construction manual. Shpg. Wt. 5 lbs.

MODEL C-3 **$19.50**

CONDENSER CHECKER KIT

Check unknown condenser and resistor values quickly and accurately as well as their operating characteristics with this fine instrument. All values are read directly on a calibrated scale. An electron beam "eye" tube indicates balance and leakage. A valuable addition to any service shop or lab. Shpg. Wt. 7 lbs.

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"APACHE" HAM TRANSMITTER KIT

HEATHKIT
MODEL TX-1
$229.50

- Modern Styling
- Rotating Slide Rule Dial
- Comoact, Stable, VFO
- Provision for SSB Adapter

This beautifully styled transmitter has just about everything you could ask for in transmitting facilities. 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. A completely redesigned, compact and stable VFO provides low drift frequency control necessary for SSB transmission. A slide rule type illuminated rotating VFO dial with full gear drive 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 (11 m with crystal control). This unit also has adjustable low-level speech clipping and a low distortion modulator stage employing two of the new 6CA7 /EL34 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. A formed one-piece cabinet with convenient access hatch provides accessibility to tubes and crystal socket. 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. A "spotting" push button is provided to allow tuning of the transmitter before switching on the final amplifier. This feature also enables the operator to "zero-beat" an incoming frequency without placing the transmitter on the air. Equip your ham shack now for top transmitting enjoyment with this outstanding unit. Shpg. Wt. 110 lbs.

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

New Styling...
New Features

HEATHKIT

HEATH COMPANY
Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.

HEATHKIT
MODEL SB-10
$89.95

SINGLE SIDEBAND ADAPTER KIT

Designed as a compatible plug-in adapter for the model TX-1 it can also be used with transmitters similar to the DX-100 or DX-100-B by making a few simple circuit modifications and still retain the normal AM and CW functions. Easy to operate and tune, the adapter employs the phasing method for generating a single sideband signal, allowing operation entirely on fundamental frequencies. The critical audio phase shift network is supplied, completely preassembled and wired in a sealed plug-in unit. Features include single-knob bandswitching for operation on 80, 40, 20, 15 and 10 meters, an easy-to-read panel meter, built-in electronic voice control with anti-trip circuit. Enjoy the advantages of SSB operation by adding this fine kit to your ham shack now. Shpg. Wt. 14 lbs.

MODEL
DX-100-B
$189.50

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

DX-100-B PHONE & CW TRANSMITTER KIT

The same fine performance of the time proven DX-100 is retained in the DX-100-B with improvements in the crystal and loading circuits. The one-piece formed cabinet has convenient access hatch for changing crystals, etc. and the chassis is punched to accept sideband adapter modifications. Features a built-in VFO, modulator and power supply, complete shielding to minimize TVI, and a pi network output coupling to match impedances from 50 to 72 ohms. RF output is in excess of 100 watts on phone and 120 watts on CW. Covers 160 through 10 meters. Single-knob bandswitching and illuminated VFO dial and meter face. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. Designed for easy assembly. Measures 11⅝" H. x 19½" W. x 16" D. Shpg. Wt. 107 lbs.

MODEL DX-40 **$64.95**

DX-40 PHONE & CW TRANSMITTER KIT

Operates on 80, 40, 20, 15, 11 and 10 meters, using a single 6146 tube in the final for 75 watt plate power input CW, or 60 watts phone. Single-knob bandswitching, pi network output, complete shielding, provision for three crystals and VFO. D'Arsonval movement panel meter. Shpg. Wt. 25 lbs.

MODEL DX-20 **$35.95**

DX-20 CW TRANSMITTER KIT

This fine unit covers 80, 40, 20, 15, 11 and 10 meters with single-knob bandswitching. Features a 6DQ6A tube in the final for 50 watt plate power input, pi network output, complete shielding to minimize TVI. Easy to build with complete instructions supplied. Shpg. Wt. 19 lbs.

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"MOHAWK" HAM RECEIVER KIT

Designed for ham band operation and for maximum stability and accuracy, the Heathkit "Mohawk" receiver will let you enjoy ham activities to the utmost. This 15-tube receiver features double conversion with IF's at 1682 kc and 50 kc and covers all the amateur frequencies from 160 through 10 meters on seven bands. An extra band is calibrated to cover 6 and 2 meters using a converter. The "Mohawk" is specially designed for single-sideband reception with crystal controlled oscillators for upper and lower sideband selection. A completely pre-assembled, wired and aligned front end coil/bandswitch assembly assures ease of construction and top performance. Many more important features are provided in this outstanding receiver for dependable and effective amateur communications. Ruggedly constructed with well rated components throughout. Shpg. Wt. 66 lbs. Matching accessory speaker kit; optional extra. Model AK-5. $9.95. Shpg. Wt. 8 lbs.

- **Prewired and Aligned Coil/Bandswitch Assembly**
- **Crystal Controlled Oscillators for Drift-Free Reception**

HEATHKIT MODEL RX-1 **$274.95**

HEATHKIT MODEL AR-3 **$29.95** (LESS CABINET)

ALL-BAND RECEIVER KIT

A fine receiver for the beginning ham or short wave listener. Frequency coverage is from 550 kc to 30 mc in four bands. Features include bandswitch, bandspread tuning, phone-standby-CW switch, antenna trimmer, noise limiter, RF and AF gain controls and headphone jack. Easy to build. Shpg. Wt. 12 lbs.

MODEL QF-1 **$9.95**

"Q" MULTIPLIER KIT

Use with any receiver with IF frequency between 450 and 460 kc to add additional selectivity for separating two signals or to reject one signal and eliminate heterodyne. A great help on crowded phone and CW bands. Not for use with AC-DC type receivers. Simple to connect with cable and plugs supplied. Shpg. Wt. 3 lbs.

MODEL CA-1 **$13.95**

"AUTOMATIC" CONELRAD ALARM KIT

This easy-to-build device gives instant warning and cuts AC power to your transmitter when a monitored station goes "off-the-air". Use with any radio receiver having an AVC circuit. A sensitivity control adjusts to various AVC levels. Incorporates a heavy duty six-ampere relay and manual "reset" button to reactivate the transmitter. Complete instructions provided for connection to receiver. Shpg. Wt. 4 lbs.

"SENECA" VHF TRANSMITTER KIT

Brand new in every respect, the model VHF-1 "Seneca" is the latest addition to our line of ham transmitters. This self-contained 6 and 2 meter transmitter features built-in VFO, modulator, and dual power supply. A pair of 6146 tubes are employed in the push-pull final amplifier stage and features up to 120 watts input on phone and 140 watts input on CW in the 6 meter band. Slightly less in the 2 meter band to prolong amplifier tube life. Panel controls allow VFO or crystal control, phone or CW operation on both amateur bands. Four switch-selected crystal positions. Complete RF shielding to minimize TVI. Spotting push-button provided. The VFO slide rule type dial features edge-lighting and vernier tuning. An ideal transmitter for the ham who wants to extend operation into the VHF region. Shpg. Wt. 56 lbs.

HEATHKIT MODEL VHF-1 **$159.95**

MODEL AM-2 **$15.95**

REFLECTED POWER METER KIT

Check the match of your antenna transmission system by measuring the forward and reflected power or standing wave ratio from 1:1 to 6:1. Handles a peak power of well over 1 kilowatt and may be left in antenna feed line. No external power required. 160 through 6 meters. For 50 or 75 ohm lines. Shpg. Wt. 3 lbs.

MODEL B-1 **$8.95**

BALUN COIL KIT

Unbalanced coax lines can be matched to balance lines of either 75 or 300 ohms by using this balun coil kit. Use without adjustment from 80 through 10 meters at power up to 200 watts. May be located any distance from transmitter or antenna. Protective cover included. Shpg. Wt. 4 lbs.

MODEL VX-1 **$23.95**

ELECTRONIC VOICE CONTROL KIT

This unique device lets you switch from receiver to transmitter merely by talking into your microphone. Provision is made for receiver and speaker connections and also for a 117 volt antenna relay. Adjustable to all conditions by sensitivity and variable time delay controls provided. Shpg. Wt. 5 lbs.

MODEL VF-1 **$19.50**

VARIABLE FREQUENCY OSCILLATOR KIT

Far below the cost of crystals to obtain the same frequency coverage this VFO covers 160, 80, 40, 20, 15, 11 and 10 meters with three basic oscillator frequencies. Better than 10 volts RF output on fundamentals. Requires only 250 volts DC at 15 to 20 ma, and 6.3 VAC at 0.45 a. Illuminated dial reads direct. Shpg. Wt. 7 lbs.

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Beautifully Styled With Plenty of Room For The Most Complete Stereo System

MODEL SE-1 (center unit) **$149.95** Shpg. Wt. 162 lbs.

MODEL SC-1 (speaker enclosure) **$39.95** each Shpg. Wt. 42 lbs.

STEREO EQUIPMENT CABINET KIT

This superbly styled cabinet ensemble is designed to hold your complete home stereo hi-fi system, consisting of a "stereo equipment center" flanked by two individual "stereo wing speaker enclosures". The unit has room for all the components required for stereo sound. Although designed to hold Heathkit stereo components, it is not frozen to this arrangement. The kit is supplied with mounting panels precut to accommodate Heathkits, but interchangeable blank panels are also furnished so you can mount any equipment you may already have. The precut panels accommodate the Heathkit AM-FM tuner (PT-1), stereo preamplifier (SP-1 & 2), and record changer (RP-3). Record changer chassis pulls out easily for convenient loading and unloading. Adequate space is provided for record storage and a pair of matching Heathkit power amplifiers (from 12 to 70 watts). The stereo wing speaker enclosures are open backed, cloth grilled cabinets designed to hold the Heathkit SS-2 or similar speaker systems. The cabinets are available in beautifully grained ¾" solid core Phillipine mahogany or select birch plywood suitable for the finish of your choice. The matched grain sliding tape deck access door on top pops-up flush when closed. Entire top features a shaped edge. Hardware and trim of brushed-brass and gold finish. Rich toned grille cloth is flecked in gold and black. No woodworking experience required. All parts precut and predrilled for easy assembly. Maximum overall dimensions (all 3 pieces): 82¾" W. x 36½" H. x 20" D. Center Cabinet: 47½" W. x 36½" H. x 20" D.

CHAIRSIDE ENCLOSURE KIT

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 AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier along with the majority of record changers which will fit in the space provided. Changer compartment measures 17¾" L. x 16" W. x 9⅜" D. Adequate space is provided in the rear of the unit to house any of the Heathkit amplifiers designed to operate with the WA-P2. Good ventilation is achieved through properly placed slots in the bottom and back of the enclosure. Overall dimensions are 18" W. x 24"H x 35½" D. All parts are precut and predrilled for easy assembly. The Contemporary cabinet is available in either mahogany or birch, and the Traditional cabinet is available in mahogany suitable for the finish of your choice. Beautiful hardware supplied. Shpg. Wt. 46 lbs.

HIGH FIDELITY RECORD CHANGER KIT

Every outstanding feature you could ask for in a record changer is provided in the Heathkit RP-3, the most advanced changer on the market today. The unique turntable pause during the change cycle saves wear and tear on your records by eliminating the grinding action caused by records dropping on a moving turntable or disk. Record groove and stylus wear are practically eliminated through proper weight distribution and low pivot point friction of the tone arm. Clean mechanical simplicity and precision parts give you turntable performance with the automatic convenience of a record changer. Flutter and wow, a major problem with automatic changers, is held to less than 0.18% RMS. An automatic speed selector position allows intermixing 33⅓ and 45 RPM records regardless of their sequence. Four speeds provided: 16, 33⅓, 45 and 78 RPM. Changer is supplied complete with GE VR II cartridge with diamond LP and sapphire 78 stylus, changer base, stylus pressure gauge and 45 RPM spindle. Shpg. Wt. 19 lbs.

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"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

The popularity of this modestly priced speaker system attests to its high fidelity performance. The SS-2 provides an ideal basic speaker for your home hi-fi system. Flexibility of design allows it to be used as a table top model or as an attractive consolette with optional legs. May also be used as a supplementary speaker in more advanced systems or as replacement speaker for TV sets, etc. The specially designed tweeter horn rotates 90 degrees allowing you to use the speaker in an upright position if desired, as in the Heathkit stereo wing speaker enclosures. Total frequency range is from 50 to 12,000 cycles-per-second. An 8" mid-range woofer covers from 50 to 1,600 CPS while a compression-type tweeter with flared horn covers 1,600 to 12,000 CPS. Both speakers are by Jensen. A variable balance control allows level adjustment of the high frequency speaker. Power rating is 25 watts. Constructed of ½" veneer-surfaced plywood suitable for light or dark finish. All wood parts are precut and predrilled for simple, quick assembly. An added feature of the SS-2 is that, although an outstanding performer in its own right, it may be combined with the SS-1B "range extending" speaker system later to extend the frequency range at the high and low ends of the audio range. Build in just one evening for many years of listening enjoyment. Shpg. Wt. 26 lbs.

ATTRACTIVE BRASS TIP ACCESSORY LEGS convert SS-2 into handsome consolette. 14" legs screw into brackets provided. All hardware included. Shpg. Wt. 3 lbs. No. 91-26. **$4.95.**

Assemble it in

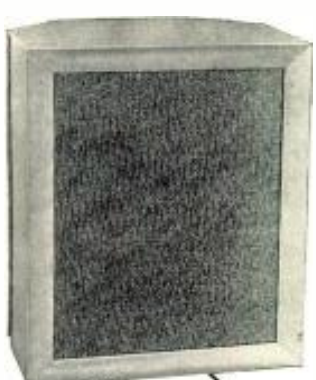
Just One Evening

OPTIONAL LEGS
NO. 91-26 $4.95

DIAMOND STYLUS HI-FI PICKUP CARTRIDGE

MODEL MF-1 **$26.95**

Replace your present pickup with the MF-1 and enjoy the fullest fidelity your library of LP's has to offer. Designed to Heath specifications to offer you one of the finest cartridges available today. Nominally flat response from 20 to 20,000 CPS. Shpg. Wt. 1 lb.



Extended Frequency Range for Your SS-2

"RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

Designed exclusively for use with the SS-2, the SS-1B employs a 15" woofer and a super tweeter horn to extend the range of the SS-2 to an overall response of ±5 db from 35 to 16,000 CPS. When used together the two units form an integrated four-speaker system and are designed to combine into a single piece of attractive furniture. Impedance of the SS-1B is 16 ohms and power rating 35 watts. A control is provided to limit the output of the super tweeter. Constructed of beautiful ¾" veneer-surfaced plywood suitable for light or dark finish of your choice. All parts are precut and predrilled for simple assembly. No woodworking experience required. All hardware included. Shpg. Wt. 80 lbs.

"LEGATO" HI-FI SPEAKER SYSTEM KIT

It is difficult to describe in words the performance of this magnificent speaker system. You may never find absolute perfection in reproduced sound, but the Legato comes as close to achieving it as anything yet devised. Perfect balance, precise phasing, and adequate driver design combine to produce the superb quality of reproduction inherent in this instrument. The crisp, clear high frequencies and rich full bass engulf you in a sea of life-like tone. Two 15" Altec Lansing low frequency drivers cover frequencies from 25 to 500 CPS while a specially designed exponential horn with high frequency driver covers 500 to 20,000 CPS. The unique crossover network is built-in making electronic crossovers unnecessary. The legato emphasizes simplicity of line and form to blend with modern or traditional furnishings. Constructed of ¾" veneer-surfaced plywood in either African mahogany or white birch suitable for light or dark finishes of your choice. All parts are precut and predrilled for easy assembly. Shpg. Wt. 195 lbs.

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Easy to buy...

Easy to build

Easy to use...

HEATHKIT®

HEATH COMPANY

Benton Harbor 15, Michigan

High Fidelity AM and FM reception in a Single Set

HEATHKIT MODEL PT-1 **$89.95**

Professional Stereo-Monaural AM-FM Tuner Kit

Enjoy stereophonic broadcasts as well as outstanding individual AM and FM radio reception with this deluxe 16-tube AM-FM-stereophonic tuner combination. Features include three etched circuit boards for high stability and ease of construction, prewired and prealigned FM front end, built-in AM rod antenna, tuning meter, FM-AFC (automatic frequency control) with on-off switch, and flywheel tuning. A multiplex jack is also provided. AM and FM circuits are tuned individually making it ideal for stereo applications since both AM and FM can be used at the same time. A switch selected tuning meter functions on either AM or FM. Cathode follower outputs with individual level 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. Anywhere from 1 to 4 limiters or IF's assure smooth, non-flutter reception on weak or strong stations alike. The silicon diode power supply is conservatively rated and is fuse-protected assuring long service life. Flywheel tuning combined with new edge-lighted slide-rule dial provide effortless tuning. Use of three printed circuit boards greatly simplifies construction. Vinyl-clad steel cover is black with inlaid gold design. Shpg. Wt. 20 lbs.

MODEL FM-3A **$26.95**

HIGH FIDELITY FM TUNER KIT

The Heathkit FM-3A Tuner will provide you with years of inexpensive hi-fi enjoyment. Features broad-banded circuits for full fidelity and better than 10 uv sensitivity for 20 db of quieting. Covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures neglible drift after initial warmup. Employs a high gain cascode IF amplifier and has AGC. Power supply is built-in. IF and ratio transformers are prealigned as is the front end tuning unit. Two outputs provided, one fixed, one variable, with extra stage of amplification. Shpg. Wt. 8 lbs.

MODEL BC-1A **$26.95**

HIGH FIDELITY AM TUNER KIT

The BC-1A incorporates many features not usually expected in an AM circuit particularly in this low price range. It features a special detector using crystal diodes and broad band-width IF circuits for 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. Covers the complete broadcast band from 550 to 1600 kc. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs and built-in power supply. Shpg. Wt. 9 lbs.

MODEL W-6 **$109.95**

"HEAVY DUTY" 70 WATT HI FI AMPLIFIER KIT

Designed for "rugged duty" called for by advanced hi-fi systems and P.A. networks. Silicon diode rectifiers assure long life and heavy duty transformer provides excellent power supply regulation. Variable damping control provides optimum performance with any speaker system. Quick change plug selects 4, 8 and 16 ohm or 70 volt output and the correct feedback resistance. Shpg. Wt. 52 lbs.

MODEL W-5 **$59.75**

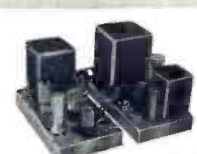
25 WATT HI FI AMPLIFIER KIT

Enjoy the distortion-free high fidelity sound from one of the most outstanding hi-fi amplifiers available today. Features include a specially designed Peerless output transformer and KT66 tubes. Frequency response is ±1 db from 5 to 160,000 CPS at 1 watt and within 2 db 20 to 20,000 CPS at full 25 watts output. Hum and noise are 99 db below 25 watts. Shpg. Wt. 31 lbs.

MODEL W-4AM **$39.75**

SINGLE CHASSIS 20 WATT HI FI AMPLIFIER KIT

A true Williamson-type high fidelity circuit, the W-4AM features 5881 push-pull output tubes and a special Chicago-Standard output transformer to guarantee you full fidelity at minimum cost. Harmonic distortion is 1.5% and IM distortion is below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps for 4, 8 or 16 ohm speakers. Shpg. Wt. 28 lbs.



MODEL W-3AM **$49.75**

DUAL CHASSIS 20 WATT HI FI AMPLIFIER KIT

Another famous Williamson-type high fidelity circuit, the W-3AM features the famous Acrosound TO-300 "ultralinear" output transformer and 5881 tubes. The power supply and main amplifier are on separate chassis for installation flexibility. Harmonic distortion is less than 1% and IM distortion is less than 1.2% at 20 watts. Shpg. Wt. 29 lbs.

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HEATHKIT MODEL SP-2 (STEREO) $56.95

Monaural-Stereo Preamplifier Kit (2-Channel Mixer)

This unique kit allows you to purchase it in the monaural model if desired and then add the second or stereo channel later. The SP-2 features 12 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. A separate on-off switch is provided. The function switch provides settings for stereo, 2-channel mix, channel A or B for monaural use. Inputs consist of tape, mike, mag phono and three high-level inputs. NARTB equalization and RIAA, LP, 78 record compensation are provided. A remote balance control is included. Printed circuit boards for easy assembly. Built-in power supply. Shpg. Wt. 15 lbs.

MODEL SP-1 (MONAURAL)
$37.95 Shpg. Wt. 13 lbs.

MODEL C-SP-1 (CONVERTS SP-1 TO SP-2)
$21.95 Shpg. Wt. 5 lbs.

HEATHKIT MODEL WA-P2 $19.75

"MASTER CONTROL" PREAMPLIFIER KIT

Control your hi-fi system with this compact unit. Features 5 switch-selected inputs to accommodate a record changer, tape recorder, AM tuner, FM tuner, TV receiver, microphone, etc., each with level control. Provision also for a tape recorder output. Equalization for records through separate turnover and rolloff switches for LP, RIAA, AES and early 78's. Shpg. Wt. 7 lbs.

MODEL W-7M
$54.95

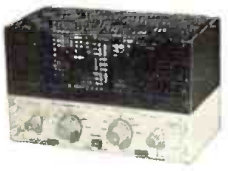
"EXTRA PERFORMANCE" 55 WATT HI FI AMPLIFIER KIT

Enjoy this high fidelity power amplifier at less than a dollar per watt. Full audio output and maximum damping is conservatively rated at 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout the entire range. Features famous "bas-bal" circuit, EL-34 output tubes and special 70 volt output. Shpg. Wt. 28 lbs.

MODEL UA-1
$21.95

"UNIVERSAL" 12 WATT HI FI AMPLIFIER KIT

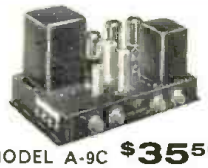
The versatility and economy of this fine kit make it a truly "universal" hi-fi amplifier. An ideal basic amplifier for any hi-fi system or a perfect addition to gear your present hi-fi system to stereo sound. Uses 6BQ5/EL84 push-pull output tubes for less than 2% harmonic distortion throughout the entire audio range. Shpg. Wt. 13 lbs.



MODEL XO-1
$18.95

ELECTRONIC CROSSOVER KIT

This unique instrument separates high and low frequencies and feeds them through 2 amplifiers into separate speakers. Located ahead of the main amplifier, it virtually eliminates IM distortion and matching problems. Note: Not for use with Heathkit Legato speaker system. Shpg. Wt. 6 lbs.



MODEL A-9C $35.50

GENERAL-PURPOSE 20 WATT AMPLIFIER KIT

Designed for home installation as well as for PA requirements, the A9-C combines a preamplifier, main amplifier and power supply all on one chassis. Four switch-selected inputs are provided as well as separate bass and treble tone controls offering 15 db boost and cut. Detachable front plate allows for custom installation. Shpg. Wt. 23 lbs.

MODEL SW-1 $24.95

SPEEDWINDER KIT

A real timesaver, the SW-1 leaves your tape recorder free for operation while rewinding tape at the rate of 1200 feet in 40 seconds. Prevents unnecessary wear to the tape and recorder. Handles up to 10½" tape reels. Handles 800' reels of 8 and 16 millimeter film as well. Automatic shutoff prevents whipping at end of rewind. Shpg. Wt. 12 lbs.

NO. 401-6
$7.50

12" UTILITY SPEAKER KIT

Replace inferior speakers in radio or TV sets to obtain better tone quality or set up an auxiliary speaker for testing purposes with this convenient, high quality speaker. The speaker will handle up to 12 watts with a frequency response of ±5 db from 50 to 9,000 CPS. Speaker impedance is 8 ohms and has a 6.8 oz. magnet. An outstanding dollar value. Shpg. Wt. 7 lbs.

MODEL TK-1 $9.95

COMPLETE TOOL SET

These basic tools are all you need to build any Heathkit. The pliers, diagonal side cutters, 2 screwdrivers, and soldering iron are all of top quality case hardened steel for hard duty and long life. Pliers and side cutters are equipped with insulated rubber handles for safety. A good example of just how easy Heathkit building really is. Shpg. Wt. 3 lbs.

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HIGH FIDELITY TAPE RECORDER KIT

The model TR-1A tape deck and preamplifier combination provides all the facilities you need for top quality monaural recording/playback with fast forward and rewind functions. 7½ and 3¾ IPS tape speeds are selected by changing belt drive. Flutter and wow are held to less than 0.35%. Frequency response at 7½ IPS ±2.0 db 50-10,000 CPS, at 3¾ IPS ±2.0 db 50-6,500 CPS. Both units may be mounted together or separately affording high flexibility in every application. Features include NARTB playback equalization —separate recording and playback gain controls —cathode follower output and provision for mike or line input. Signal-to-noise ratio is better than 45 db below normal recording level with less than 1% total harmonic distortion. A filament balance control allows adjustment for minimum hum level. Complete instructions provided for easy assembly. Overall dimensions of tape deck and preamp is 15½" W. x 13½" H. x 8" D. Shpg. Wt. 24 lbs.

HEATHKIT TR-1A
$99.95

Includes tape deck assembly, preamplifier and roll of tape.

HEATHKIT TE-1
$39.95

Tape preamplifier sold separately if desired. Shpg. Wt. 10 lbs.

Many more Heathkits to choose from

hi-fi: Amplifiers—Preamplifiers—Speaker Systems—AM/FM Tuners—Equipment Cabinets—Record Player—Tape Recorder—Electronic Crossover—Stereo Equipment.

test: Oscilloscopes—Voltmeters—RF Signal Generators—AF Generators—Analyzers—Battery Eliminators—Tube Checkers—Condenser Checkers—Computer—Color Bar & Dot Generator—Sweep Generator—Impedance Bridge—Power Supplies—Probe Kits—R/C Decade & Substitution Kits.

ham radio: Transmitters—Receivers—Antenna Accessories—Voice Control—Conelrad Alarm—Variable Frequency Oscillator—SSB Adapter—"Q" Multiplier.

marine: Direction Finders—Marine Converter—Rudder Position Indicator—Fuel Vapor Detector—Charge Indicator—Power Meter.

general: Tool Set—6-Transistor Portable Radio—Radiation Counter—Electronic Timer—Crystal Receiver—Superheterodyne Receiver.

Send for Catalog describing over 100 easy-to-build electronic instruments in kit form. Complete specifications and detailed information on Hi-Fi—Test—Ham and Marine kits.

Save with Heathkits...the quality name in kit form electronics.

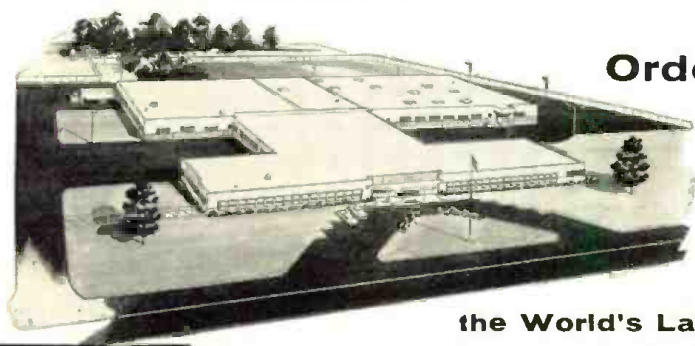
www.americanradiohistory.com

"BOOKSHELF" 12 WATT AMPLIFIER KIT

Here are a few of the reasons why this attractive amplifier is such a tremendous dollar value. You get rich, full range, high fidelity sound reproduction with low distortion and noise . . . plus "modern styling". The many features include full range frequency response 20 to 20,000 CPS ±1 db with less than 2% distortion over this range at full 12 watt output—its own built-in preamplifier with provision for three separate inputs: mag phono, crystal phono, and tuner—RIAA equalization—separate bass and treble tone controls—special hum control—and it's easy-to-build. Complete instructions and pictorial diagrams show where ever part goes. Cabinet shell has smooth leather texture in black with inlaid gold design. Cabinet measures 12½" W. x 8⅜" D. x 4⅜" H. Output transformer has taps at 4, 8 and 16 ohms to match the speaker of your choice. An ideal unit to convert your present hi-fi system to stereo sound. Shpg. Wt. 15 lbs.

An Amplifier, Preamplifier all in one!

HEATHKIT EA-2 **$28.95**



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HEATHKITS are also available at your Dealer see listing on next page

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Authorized HEATHKIT Dealers

Although you will find local prices for Heathkits higher than those listed in Heath Company advertising . . . we're sure you will agree that this increase is justified. Your dealer pays all transportation charges, makes your kit immediately available, provides demonstration facilities, offers you a reliable source for parts and fast service . . . and stands ready to counsel or advise you on any problems that might arise.

Naturally, you have the continued privilege of dealing directly with the Heath Company if you wish. Now however, you have the added convenience of buying locally.

The following dealers have been carefully selected and are now ready to serve you.

CALIFORNIA

DUNLAP RADIO & TV
928 Main Street
Chico, California

DUNLAP RADIO & TV
2617 Tulare Street
Fresno, California

BUSHNELL SOUND CORP.
12026 Wilshire Blvd.
Los Angeles, California

KIERULFF SOUND CORP.
820 West Olympic Blvd.
Los Angeles, California

DUNLAP RADIO & TV
5th & "J" Street
Marysville, California

DUNLAP RADIO & TV
234 West 17th Street
Merced, California

DUNLAP RADIO & TV
419 10th Street
Modesto, California

TEL-RAD ELECTRONICS
639 National
National City, California

ZACK RADIO SUPPLY CO.
654 High Street
Palo Alto, California

DUNLAP RADIO & TV
18th & "R" Street
Sacramento, California

TEL-RAD ELECTRONICS
3453 University Avenue
San Diego, California

ZACK RADIO SUPPLY CO.
1422 Market Street
San Francisco, California

DUNLAP RADIO & TV
27 North Grant Street
Stockton, California

VALLEY SOUND CORP.
18841 Ventura Blvd.
Tarzana, California

DUNLAP RADIO & TV
1725 Mooney Avenue
Visalia, California

MASSACHUSETTS

AUDIONICS, INC.
1348 Boylston Street
Boston 15, Massachusetts

MICHIGAN

VOLTA ELECTRONICS
6716 Park Avenue
Allen Park, Michigan

HI-FI WORKSHOP
16400 W. Seven Mile Road
Detroit 35, Michigan

NEW JERSEY

FEDERATED PURCHASER
1021 US Route 22
Mountainside, New Jersey

FEDERATED PURCHASER
114 Hudson Street
Newark, New Jersey

NEW YORK

CROSS ISLAND ELEC. INC.
247-40 Jericho Turnpike
Bellerose, New York

ACME ELECTRONICS
59 Willoughby Street
Brooklyn, New York

GEM ELECTRONICS
34 Hempstead Turnpike
Farmingdale, New York

BEAM ELECTRONICS
101-10 Queens Blvd.
Forest Hills, New York

GEM ELECTRONICS
234 Broadway, Hicksville, N.Y.

ARROW ELECTRONICS
525 Jericho Tpk., Mineola, N.Y.

DAVIS RADIO DISTR.
70 East 3rd Street
Mount Vernon, New York

ARROW ELECTRONICS
65 Cortlandt Street
New York City, New York

HARVEY RADIO CO.
103 West 43rd Street
New York City, New York

OREGON

ECCLES ELECTRIC CO.
237 N.E. Broadway
Portland, Oregon

CECIL FARNES CO.
440 Church Street, N.E.
Salem, Oregon

PENNSYLVANIA

FEDERATED PURCHASER
1115 Hamilton Street
Allentown, Pennsylvania

FEDERATED PURCHASER
925 Northampton Street
Easton, Pennsylvania

AUSTIN ELECTRONICS
1421 Walnut Street
Philadelphia, Pennsylvania

RHODE ISLAND

AUDIONICS, INC.
790 North Main Street
Providence, Rhode Island

VIRGINIA

KEY ELECTRONICS, INC.
126 South Wayne Street
Arlington, Virginia

WASHINGTON

SEATTLE RADIO SUPPLY
2117 Second Avenue
Seattle 1, Washington

Obviously, this is a limited number of dealers. Careful selection of reliable, qualified dealers is a slow process . . . so please bear with us if your area has not yet been covered. Thank You.

HEATH COMPANY
Benton Harbor, Mich.
A Subsidiary of Daystrom, Inc.

World's Fastest Message Printer

New 3000-word-a-minute teletypewriter prints at a speed 20 times faster than most people can talk.

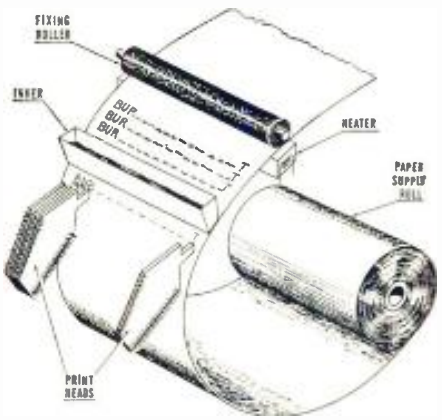
Officer is holding 3000-word message that has been typed by new Army teleprinter in just one minute flat.

A NEW 3000-word-a-minute teletypewriter, the fastest general-purpose message printer in communications history, has been announced by the Dept. of the Army. The printer, developed jointly with the *Burroughs Corp.*, prints four full lines of text a second—50 times faster than a news service teletypewriter, 45 times faster than an average typist, and 20 times faster than most people can talk.

Operating at a lower speed of 750 words a minute for the Army, the new electronic messenger will do the work of eight of today's military printers, promising substantial savings in personnel and equipment. It also gets completed messages to their destination eight times faster. The printer may have broad civilian applications. It can provide the vastly increased message speed long sought by weather forecasting networks, stock exchanges, telegraph offices, and news gathering enterprises.

A standard teletypewriter is an automatic typewriter that responds to electrical signals. Linked by radio or telephone lines, it can print at 60 words a minute messages sent from distant stations. The new teletypewriter does not use ordinary keys for its ultra-fast reception speed. At 750 wpm, they could barely get into the air or would jam up on the first word. Instead, letters are shot at the paper electronically by a bank of electrode "guns." Each "gun," or print head, forms a small charged area in the pattern of a single letter on a high-resistivity coated paper surface. The electrostatic latent image formed by the charge area is made visible by application of powdered ink, permanently fixed by the application of heat.

The recording head is made up of 35 tiny wires leading into and through a triangular-shaped piece of plastic. The wires are polished flush with one corner of the triangle, which is the print head, to form a rectangle seven wires high by five wires wide. This is the matrix—72 of them in a row to form a printing line. They do not touch the paper but are maintained at a fixed distance from the paper surface. Electric pulses selectively charge the proper combination of wires in each head to form an image of a character. It requires only a small fraction of a second to set up the right charge pattern for an entire line of type. During the recording stage, the electrical discharge from the print head to a metal plate is used as the source of charge to form the electrostatic image on the paper. By using a low negative voltage on the point electrodes, tiny, round dots are produced that form the letters. This process is referred to as "electrostatic recording."



A latent electrostatic image, formed by a row of 72 print heads, is made visible by powdered ink, then fixed by heating.

The machine operates from standard code tape, or it can be plugged into long-distance radio or telephone circuits to print out messages sent from across the continent or overseas. Another use of this unique printing technique will be to type out the calculations of new military electronic computers.

In mass production, the high-speed printer is expected to cost half as much as the bank of eight standard printers it can replace. And since there are no moving parts, except for the paper transport, maintenance should be cut by fifty per-cent. Repair of the electronic circuits will be greatly simplified by the system's replaceable plug-in units. —30—

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Independent TV-Radio Service Dealers:

THIS AD IS FOR YOU! *

next time you call a TV-Radio Service Dealer... ask yourself these 4 questions

1 DOES HE HAVE AN ESTABLISHED BUSINESS FACILITY?

It takes a big investment to set up a properly equipped TV-Radio service operation. When the Service Dealer has a place of business—particularly in your community — you can be certain he's planning to stay. Your business is important to him. As an independent small businessman in your community he's going to do everything he can to satisfy you. It's the only way he can assure his own future.

2 DOES HE GUARANTEE HIS WORK AND PARTS?

It's standard practice to guarantee work and parts and most qualified dealers do so. Be sure to find out the duration of the guarantee so that you will know just how long you are protected. Remember, however, the guarantee covers only the parts replaced *by the dealer, not everything in the set.* If some other tube or component fails dusing the guarantee period the dealer cannot be held responsible.

3 DOES HE CHARGE A FAIR PRICE FOR A HOME SERVICE CALL?

Be sure the Service Dealer you choose makes a charge sufficient to cover his time and transportation expenses. Like any other businessman, your Service Dealer has basic costs . . . overhead, rent, taxes, insurance, salaries, etc. . . . expenses that must be considered when he establishes his service call charges.

4 DOES HE PROVIDE AN ITEMIZED BILL?

He should, for his own protection as well as yours. Then you know exactly what work was done, which parts replaced and exactly how much each cost. You both know what replacements are covered by the guarantee in case of an early failure.

If the answer is *yes* to all four of these questions, the chances are you'll receive fast, competent, expert TV-Radio service at prices that are reasonable.

What's more, the chances are he'll be a *Raytheon Bonded Electronic Technician* and that's an added bonus for you. These expert technicians offer a 90 day work and parts guarantee that *is backed by a Bond* issued through one of America's largest insurance companies. They observe a strict 8-Point Code of Business Ethics designed to protect you. For the quick, safe, sure solution to all TV-Radio servicing problems, call a Raytheon *Bonded* Electronic Technician.

For Your Convenience Raytheon TV-Radio Service Dealers Are Listed In The Yellow Pages of Your Telephone Directory

Raytheon Quality TV and Radio Tubes Mean Better Set Performance for You . . . When a Service Dealer replaces old tubes with Raytheon Tubes you're sure of long life and lasting operation. Produced by Raytheon, pioneers in electronics, these fine tubes are made to the same rigid standards of quality and precision that are designed into the superb Raytheon Tubes. Transistors and Diodes used in 14 of America's major missiles. A lifetime of experience in the development and production of Raytheon Tubes for military, industrial and commercial applications is behind them. That's why you are certain of satisfaction from Raytheon TV and Radio Tubes.

RAYTHEON
Excellence in Electronics

Raytheon Manufacturing Company, Distributor Products Division, 55 Chapel Street, Newton 58, Massachusetts

* Raytheon is running this advertisement in the January 19, 1959 editions of NEWSWEEK and TIME magazines to help you. Read it carefully. It makes four simple suggestions to set owners that should result in substantial increases in service business for qualified Independent TV-Radio Service Dealers. It clarifies the set owners' misunderstandings about the standard work and parts guarantee. Giant blow-ups of this advertisement are available from your Raytheon Tube Distributor at no cost to you. Be sure to feature one in your shop window.

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DYNACO

STEREODYNE PHONO PICK UP

This new, unique pickup is made in Denmark by Bang and Olufsen. It features a push pull magnetic principle (patent pending) which permits realization of the full potentialities of the most modern recording techniques. The special attributes which make the Stereodyne an outstanding stereo pickup make it equally exceptional for monophonic discs. On any type of record the Stereodyne offers smooth and natural sound—firm clean bass and sparkling treble—while its light tracking pressure insures negligible record wear.

BEST in every way . . .

- **Wide frequency response**
  Smooth peak free response from 30 cps to over 15 Kc
- **True Stereo**
  Highest channel separation over entire audio spectrum
- **Precision balance**
  Both channels identical
  Same high compliance (5×10^{-6} cm/dyne) in all directions
- **No hum pickup**
  Balanced coil structure plus low impedance plus complete shielding eliminate hum from external fields
- **High output**
  7 millivolts per channel even on low level stereo discs provides gain to spare
- **No magnetic pull**
  Special magnetic circuit eliminates attraction to steel turntables
- **Easy installation**
  Compact size and standard mounting centers simplifies mounting. 4 terminals to avoid hum loops
- **Low price**
  Only $29.95 net including .7 mil diamond stylus (replaceable in 2 seconds)

Available from leading high fidelity dealers everywhere

DYNACO INC.

Dept. RT, 617 N. 41st St., Phila. 4, Pa.

Export Division: 25 Warren St., New York, N. Y.

Hi-Fi-Audio Product Review

JBL-RANGER "METREGON"

James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif. has recently introduced a new stereophonic loudspeaker system, the "JBL Ranger-Metregon".

The unit contains two complete two-way loudspeaker systems. Sound energy from the speakers is directed

from both sides of the enclosure toward a curved refractor panel. This integrates the two separate stereo channels into a single three-dimensional sound source. This feature is said to eliminate annoying "hole-in-the-middle" effects.

Measuring six feet wide and thirty inches high, the new unit employs an integrated stereophonic reproducer developed by the company in association with Colonel Richard H. Ranger. The enclosure (C45) is available in light or dark walnut, light or dark mahogany, light oak, Salem maple, natural birch, korina, and ebony finishes.

For a data sheet giving complete specifications on this new stereo speaker system, write the manufacturer direct and request additional information on the C45 enclosure.

STEREO-MONAURAL AMPLIFIER

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. is now offering a dual-channel basic power amplifier in kit form as the Model KT-310.

The new amplifier is rated at 18 watts per channel and may be used with a stereo preamplifier to provide two 18-watt stereo channels. It may

also be used monaurally as a single 36-watt power amplifier feeding one or more speakers or as two separate 18-watt monaural amplifiers.

Dual inputs are provided, each with individual volume control. Other controls include a channel-reverse switch and monaural-stereo mode selector. Speaker output impedances (available on each of the two sets of terminals) are 4, 8, 16, and 32 ohms, thus permitting parallel operation of two speaker systems with impedances of up to 16 ohms.

Input sensitivity per channel is .45 volt for full output. Response is flat at better than $\pm\frac{1}{2}$ db from 35 to 30,000 cps at 18 watts. Harmonic and IM distortion are below 1%. The circuit employs seven tubes including rectifier.

The kit comes complete with perforated metal cage and detailed assembly instructions. Over-all size is $9\frac{3}{16}$" ($10\frac{9}{16}$" with controls) x $5\frac{1}{4}$" x $13\frac{1}{4}$". Write the company direct for further details and price.

SOUND LEVEL METER

American Research Laboratories, Fort Atkinson, Wisconsin has developed an acoustic sound level meter to meet the requirements of the fast expanding hi-fi and audio amplifier field.

The Model D-50 includes a specially compensated microphone feeding a transistor amplifier. The amplifier is a 4-stage, high-gain, one-piece printed circuit. It has flat response from 200 to 40,000 cps. Below 200 cps the response drops off at 6 db per octave. To compensate for this drop a special equalizing network is inserted between the microphone and the amplifier input. This equalization produces a substantially flat response from 80 to over 10,000 cps. For applications where a greater range is needed, such as running over-all frequency tests on hi-fi equipment, a special chart is provided that shows the instrument response from 50 to about 15,000 cps.

When used to make frequency response tests on hi-fi set ups, this meter will provide a measurement that includes the speaker enclosure and the room acoustics as part of the over-all test.

A data sheet giving full details on the unit and its applications is available on written request.

TURNOVER STEREO CARTRIDGE

Recoton Corporation, 52-35 Barnett Ave., Long Island City 4, N. Y. has released its new compatible Series RG-745 magnetic stereo turnover cartridge

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which has been designed for use on all turntables and changers and for all speeds and types of records.

Two models are available, the RG-745-1SD "Piggy Back" and the RG745-3SD. Using a diamond .7 mil stylus on

one side of the cartridge, compatible performance may be obtained on either stereo or monaural LP records. On the turnover side is a 1 mil sapphire needle, providing a standby monaural cartridge.

The RG745-3SD is mechanically and electrically the same as the 1SD but carries a .7 mil diamond on one side and a 3 mil sapphire for 78 rpm's on the turnover side.

NEW "CUSTOM" LINE

Pine-eer Furniture, Inc., 4228 West Compton Blvd., Lawndale, Calif. has entered the hi-fi field with a line of components plus the custom cabinets in which to house them.

One of the first items to be placed on the market is an AM-FM tuner which has been tradenamed "The Silva." The circuit provides FM stereo multiplex facilities in addition to covering AM and FM broadcasts. Sensitivity is .77 μv. for 20 db quieting on FM and 3 μv. at 60% modulation for .5 volt output 6 db signal-to-noise ratio. Tuning range is 540 to 1600 kc. and 88 to 108 mc. Frequency response is 20 to 20,000 cps ±½ db on FM and 20 to 10,000 cps on AM. The tuner requires a total of eight tubes and draws 40 watts. A

new a.f.c. circuit combined with a low-drift oscillator provides a 16 db correction which captures and holds a station precisely to a tolerance of ±1 kc.

The companion stereo preamp serves as a master control and preamplifier for both stereo and monaural reproduction. The preamp includes two separate and distinct hi-fi channels on a single chassis plus four stereo outputs and eight equalization settings for all types of recording programming. There are 12 inputs for all signal sources including ceramic phono, mag-

TD-124 $99.75 net

WHAT MAKES THE TD's TOPS?

...finer for stereo...finer for mono

If you move in circles where component hi-fi is a by-word, you've no doubt heard about the Thorens TD-124 transcription turntable and its fabulous performance. But for late-comers we'd like to point up just a few of the really big features (non-technical readers may skip remarks in parentheses): • Extra heavy table for constant speed (10 lb rim-concentrated table insures low wow and flutter; higher moment of inertia than any similar table). • Exact speed (±3% adjustment on all speeds—16⅔, 33⅓, 45, 78—with built-in illuminated strobe for setting after stylus is on record). • Easy on records (unique two-table design permits starts after you've placed stylus, permits ⅔ rev. starts, makes cueing easy). • Extremely low rumble (mirror-finish main-bearing, nylon-seated ball-thrust-bearing reduce both vertical and horizontal rumble to a new low, so important for stereo). • 2-way motor rumble reduction (both an extra-large idler and an ultra-compliant belt-drive keep motor vibration and speed variations from table). Driving parts electronically balanced. No costly base necessary (only $9.00). 50/60 cycles, 100/250 volt operation.

These are just a few of the TD-124's features. Ask your dealer to tell you the whole story on the fabulous TD-124.

TD-134
$60.00 net

TD-184
$75.00 net

Now two budget-priced TD turntables

These 4-speed turntables have same basic adjustable-speed precision-drive as famous TD-124 but you save two ways: (1) they come already equipped with stereo-wired professional arm without overhang making them ideal changer replacements. (2) Some TD features have been eliminated to save you money. But they still top the performance of every similar turntable and player on the market. TD-184 has semi-automatic operation. TD-134 is manually operated. Precision metal stroboscope (50/60 cycles) furnished with each unit. 100/250 volt operation. Wooden base only $6.00.

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Company.....
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netic phono, tape head, high-level tape, TV, tuner, and multiplex FM. Frequency response is flat from 10 to 65,000 cps ±.1 db with IM of .02% at 1 volt output, each channel.

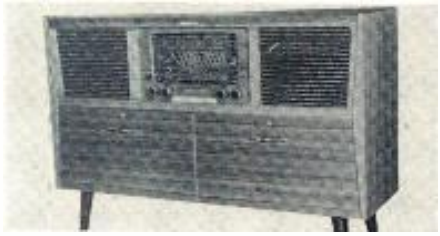
These two units are designed to be mounted on a special chassis panel which is etched to match whatever cabinet style is selected by the customer. Both modern and period enclosures are being offered by the firm, providing equipment and storage space as required.

For additional information on either the hi-fi equipment or the enclosures comprising this new line, write the manufacturer direct.

TANDBERG STEREO CONSOLE

Tandberg of America Inc., 10 E. 52nd St., New York 22, N. Y. has just released a new stereo console which features a built-in intercom system.

The Model 10 console will play back stereo discs and stereo tapes as well as serving as the central sound system for the entire home. Provision is made for the connection of remote speakers



to provide coverage of the living area. The built-in intercom feature permits hook-ups between the console speakers and remote speakers which may be located anywhere in the home.

The AM-FM radio set in the console features a short-wave tuner with four bands and 12-watt amplifier. There are four *Tandberg* speakers in the unit —two 8" and two tweeters with crossover and dividing network. The console is equipped with the company's Model 3-Stereo-4T tape unit with 4-track head and increased range of frequency response as well as a three-speed record changer. Power amplification for the second stereo channel is obtained through the Model 241 preamp.

The console is available in teak, mahogany, walnut, or blonde cabinets with brass-tipped tapered legs.

NORTRONICS STEREO AMPS

The Nortronics Company, Inc., 1015 S. Sixth St., Minneapolis 4, Minn. has announced the development of two new amplifiers designed especially for stereo playback and recording.

The Model PL-100 playback amplifier is a single-channel amplifier with ample gain to match any stereo tape head or stereo phono cartridge. It can also be used as a preamp to drive a more powerful amplifier. An equalization control allows the frequency response to be varied 15 db at 10,000 cps. This unit is housed in a modern-looking gold and black cabinet. It is rated at 3 watts.

The RA-100 recording amplifier is especially adapted to converting tape recorders to stereo recording. Two of the amplifiers will supply any magnetic tape head with all necessary audio, bias, and erase power. The RA-100 has NARTB equalization, a vu meter, and an audio monitor jack for phones or amplifier. The low-level input for

microphones may also be used for tape head or magnetic phono cartridge input for re-recording, copying, or dubbing. It is housed in a companion cabinet to the PL-100.

For full details on either or both of these new amplifiers, write the manufacturer direct.

G-S STEREO CHANGER

Glaser-Steers Corporation, 20 Main St., Belleville 9, N. J. is now offering a new version of its "Seventy-Seven" record changer which has been redesigned for stereo applications.

According to the company, rumble, wow, and flutter have been virtually eliminated by improved motor design. Features of the unit include a stereo-monaural switch on the changer deck, quick-change cartridge holders, double-channel muting switch and *RC* network to eliminate noise during change cycle and at shut-off, service receptacle for automatic amplifier shut-off, automatic and full manual operation at 16⅔, 33⅓, 45, and 78 rpm, four-pole, hum-shielded motor with dynamically balanced rotor, acoustically damped tonearm, variable stylus pressure, and jamproof mechanism.

The base measures 13½" wide, 12" deep with 3" below motorboard and

5½" above board. A wood base, mounting board, and automatic 45 rpm spindle are available as accessories at additional cost.

SMALL "DUCTED-PORT" ENCLOSURE

Argos Products Company, Genoa, Illinois has recently introduced a new small-size speaker enclosure that is especially suited to stereo system applications.

The Model TSE-1 will accommodate an 8" woofer and tweeter. It utilizes

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FREE Tape-time ruler. Gives you footage and recording time on reel. Write Dept. N1

Ferrodynamics CORPORATION
LODI, NEW JERSEY

two ducted ports (one on each end) for improved bass response. Although small enough to be used on a bookshelf (24" wide x 11" high x 10½" deep), the TSE-1 is designed for either table or floor use (standing vertically). Two of these units are ideal for stereo because of their small size and modest cost.

The enclosure is covered with heavily ribbed pyroxylin fabric and uses a new decorator pattern grille cloth. It is being offered in either dark mahogany color or blonde. Internal volume of the enclosure is 2165 cubic inches.

G-E STEREO AMPLIFIERS

The Specialty Electronic Components Dept., *General Electric Company,* W. Genesee St., Auburn, N. Y. has announced the availability of two new "Stereo Classic" stereophonic hi-fi amplifiers, the Model MS-4000 and MS-2000.

The former is a 40-watt model with two integrated 20-watt channels while the latter features two integrated 14-watt channels to provide 28 watts. Each model has two power amplifiers and two preamp control units on a single chassis. Both were designed to

handle stereo disc material as well as stereo and monaural tape and broadcast, and monaural disc program material.

Each amplifier incorporates an unusual and effective balance control which allows the listener to adjust the sound volume from both speakers for best stereo perspective. This adjustment is comparatively fine near the center point of the control, gradually raising the output from one speaker by one decibel while fading the other. As the knob is turned to its limit, the "faded" speaker is dropped to zero output. The other four of the seven knob controls are integrated dual types for simultaneous adjustment of both stereo channels. These knobs control volume, bass, treble, and contour.

Other features of these units include channel reversing to switch either channel to either speaker, rumble filter effective on all inputs, an independent switch position and input for monaural cartridges, low hum and noise, and better than 40 db channel separation.

Further information on these two new stereo amplifier/control units is available from the company.

LOW-HUM AUDIO TUBE

The Electron Tube Division of *Radio Corporation of America,* Harrison, N. J. has introduced a new triode-pentode tube which has been especially designed for high-fidelity audio applications where low hum and noise are primary design criteria.

The *RCA*-7199 plus a pair of the new 7027 high-perveance beam power tubes

for
LOWEST hum...noise... microphonics
in a high-μ dual triode . . .

the
Amperex®
ECC83 A PLUG-IN
REPLACEMENT FOR THE **12AX7**

MICROPHONICS:

Negligible in amplifiers requiring an input voltage of at least 50 mv for an output of 5 watts. No special precautions against microphonics necessary even though the tube is mounted in the near vicinity of a loudspeaker with 5% acoustical efficiency.

HUM AND NOISE LEVEL:

Better than —60 db relative to 50 mv when the grid circuit impedance is no greater than 0.5 megohms (at 60 cps), the center tap of the heater is grounded and the cathode resistor is by-passed by a capacitor of at least 100 mfd.

OTHER **Amperex TUBES** FOR HIGH-FIDELITY AUDIO APPLICATIONS:

EL84/6BQ5	9-pin power pentode; 17 W PP
6CA7/EL34	High-power pentode; 100 W PP
EF86/6267	Low-noise high-μ pentode
ECC81/12AT7	Low-noise medium-μ dual triode
ECC82/12AU7	Low-noise low-μ dual triode
GZ34	Cathode-type rectifier; 250 ma.
EZ80/6V4	9-pin rectifier; cathode; 90 ma.
EZ81/6CA4	9-pin rectifier; cathode; 150 ma.

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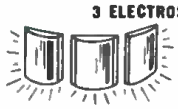

Wide 120° sound dispersion angle is attained by the exclusive Realistic three-offset element design.

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Provides all of the voltage necessary for true electrostatic speaker operation. Double fused for absolute safety!

COMPATIBLE TO ANY SPEAKER!

Regardless of size, shape or cost, the ELECTROSTAT-3 will measurably improve any speaker system!

RECOMMENDED INSTALLATION ACCESSORIES FOR THE REALISTIC "ELECTROSTAT-3"

Crossover Network Kit

Includes coils, condensers and L pad. Complete with simplified assembly instructions. Ship. Wt. 2 lbs. Available for either 8 or 16 ohms. Ship. Wt. 2 lbs.
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University N2B Crossover Network

Order No. 31CX494 Wt. 2¼ lbs. $13.72

Mallory "L" Pad Attenuators

Order No. 09B803 8 ohms, ½ lb. $2.67
Order No. 09B882 16 ohms, ½ lb. $2.67

REALISTIC in brand name, REALISTIC in price, REALISTIC in its smooth performance up to and *beyond* the range of human hearing, the fabulous Electrostat-3 is nationally recognized and "tops" among tweeters. Like all Realistic components—speakers, tuners, amplifiers, turntables—the Electrostat-3 is designed by Radio Shack audio engineers and *sold only by Radio Shack* by mail-order or through its three stores. Realistic products bring music lovers "wired hi-fi" *at or below* its kit prices and without sacrifice of any *essential* physical or electrical function!

IMPROVES EVEN THE FINEST SPEAKER SYSTEMS!

Designed to fill a void in the reproduction of high fidelity sound, the Realistic ELECTROSTAT-3 will extend the range of any speaker or speaker system to beyond 25,000 cycles. Its unbelievably wide sound dispersion angle opens a new world of acoustic brilliance!

When used with any of the finer high compliance speaker systems such as the KLH, Acoustic Research or the Realistic "Delta-7", the ELECTROSTAT-3 adds a smooth and silky high frequency response from 5000 cycles to the upper limit of audibility . . . and beyond!

EASY TO CONNECT AND USE!

The ELECTROSTAT-3 comes complete with simplified installation instructions for any speaker or system. All that is necessary is to plug in the AC power cord, connect an 8 or 16Ω crossover network, (see Realistic Crossover Kit at left) and enjoy the finest high frequency response ever heard! An 8Ω, 5000 cycle crossover network is recommended for the AR-1, AR-2 and KLH-6, and a 16Ω, 5000 cycle network for the KLH-4 and the Realistic "Delta-7".

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Ideally suited for use with the highly recommended Realistic Electrostat ·3 for full range coverage 30-25,000 cycles. Hand rubbed mahogany or oak cabinet 24½x13¼ x11" deep. 16Ω.

$8 Down
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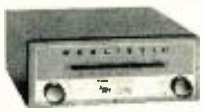
REALISTIC 15-WATT AMPLIFIER

Full 15 watts — 18-30,000 cps ±1 db @ 1 watt, 20-20,000 cps ±1 db @ full output. Wired for stereo. Gold metal case 9⅝x4⅜x 6⅛". Reg. $66.95.

$5 Down, $5 Monthly

$39.95

REALISTIC FM-AM TUNER



Loise noise cascode FM front end; sensitivity 2 uv for 30 db quieting. Ultra quiet AM. Freq. resp. 20-20,000 cps ±1 db. List $95.

$6 Down, $6 Monthly

$57.00

REALISTIC FM-II TUNER

Sensitivity: 3 uv for 30 db quieting. Freq. resp. 20-20,000 ±1 db. Gold cabinet: 9⅝x 4⅜x6⅛". List $67.50.

$5 Down, $5 Monthly

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REALISTIC "SOLO" SPEAKER

Genuine mahogany finish on 4 sides make it ideal for stereo twins. Dual-cone, 50-14,000 cps, in solid, tuned enclosure with duct-type vent. Matches 4-8 ohms. 14½x11x 10½".

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	Delta-7 Speaker	45 lbs.	RX-7065Y	79.95
	Solo Speaker	12 lbs.	RX-9036	15.95
	15-watt Amplifier	15 lbs.	33CX005Y	39.95
	FM-AM TUNER	15 lbs.	36CX023Y	57.00
	FM TUNER FM-II	9½ lbs.	36CX888-2Y	39.50

☐ Radio Shack 1959 Hi-Fi Buying Guide

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recently released by the company will provide from 30 to 40 watts amplifier output.

This new triode-pentode is of the nine-pin miniature type and utilizes a 6.3-volt, 450 ma. heater. It features a pentode unit with controlled sharp cut-off characteristics and a high transconductance (7000 μmhos) to provide high gain at low distortion. The triode unit has an amplification factor of 17.

Some of the important design features include folded-coil (single-helical) heaters in both the pentode and triode units to assure low hum; cage assembly mounted on short, stiff stem leads to reduce noise and microphonic effects; interelectrode coupling and possibility of shorts minimized by suitable location of stem leads; internal shield to minimize electrical coupling between triode and pentode units; separate cathodes for each unit; and a new cage structure having fewer welds to increase reliability.

4-CHANNEL HEAD KIT

Bell Sound Systems, Inc., 555 Marion Road, Columbus 7, Ohio has announced the availability of a 4-channel-head conversion kit which can be installed on any of the firm's stereo tape transports to handle the playback of 4-track stereo tapes.

Although the current absence of 4-track open-ended tapes from the market makes the immediate employment of the conversion kit problematical, the company has taken this step to protect both past and future customers against obsolescence.

ESL STEREO TONEARM

Electro-Sonic Laboratories, Inc., 35-54 36th St., Long Island City 6, N. Y. has announced the development of a new tonearm which has been designed to accommodate all standard stereo cartridges.

The "Gyro-Balance" arm is all new. With it turntable leveling is unnecessary—according to the company—since the unit will play records at any angle up to 90 degrees! The arm is designed to track properly at two grams. Ball-bearing construction is used throughout for both vertical and horizontal motions. This tonearm is also suitable for monophonic applications.

Write the manufacturer direct for complete specifications and price.

AUDIO CATALOGUES

CBS STEREO CARTRIDGE DATA

CBS-Hytron, Danvers, Mass., is offering copies of a one-page data sheet giving complete specifications, an outline drawing, a frequency response curve, and installation instructions for its "Constant Displacement Stereo Cartridge, Model SC-1."

This data sheet is available from the firm's Advertising Service, Parker St., Newburyport, Mass. Please specify Bulletin E-289.

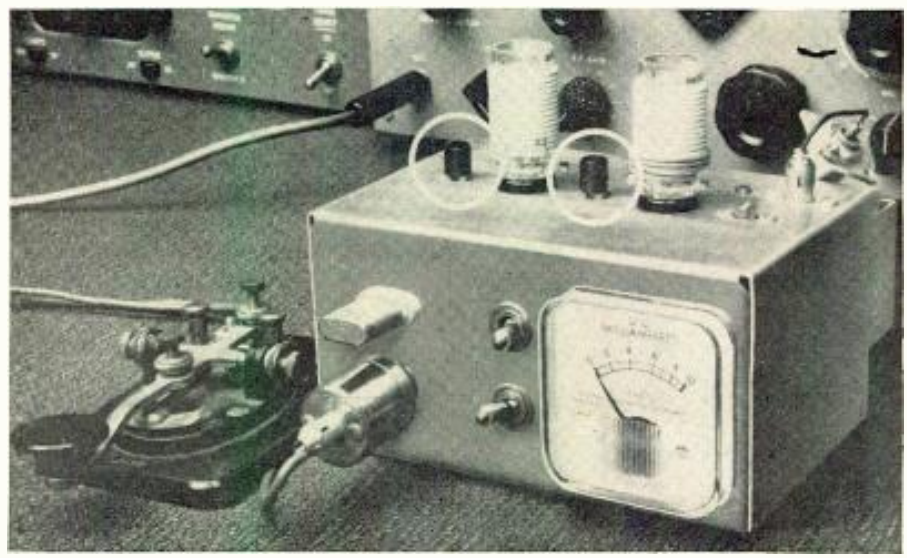
JBL SPEAKER DATA

James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif. has issued an illustrated folder on its *"JBL-*Ranger Paragon," model 44000.

The speaker system is designed as an integrated stereophonic reproducer and houses a 150-4C low-frequency driver, the 375 high-frequency driver, 075 ring radiator, and N500H and N7000 dividing networks.

For copies of the brochure on the enclosure and data sheets on the speaker components used in the system, write direct to the manufacturer at the above address. —30—

Using only one-tenth watt of power, this small transistorized radio transmitter beamed signals 16,000 miles in what is believed to be a new distance record for low-power radio transmission. With only two RCA "drift" transistors (circled), the transmitter sent a message from Ontario, California to Johannesburg, South Africa. The ham radio unit, constructed by one of our authors, Don L. Stoner, measures 3 by 4 by 6 inches without its 15-volt battery pack. Complete construction information appeared in our associate publication "Popular Electronics" (the August, 1958 issue) under the title "The Semiconductor Space Scanner."



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In a class by itself—a control center that will do **anything** and **everything** you want. Features complete input flexibility—5 Stereo inputs (including tape heads), additional 4 inputs for monaural, all can be permanently connected and controlled from single switch. Six record equalizations for monaural; RIAA for Stereo. Volume, bass and treble controls on concentric shafts with special clutch for both individual channel and overall control. Single switch selects straight Stereo; Stereo Reverse, either channel separately, or either channel into monaural output. Continuously variable loudness control; cathode follower output and special recorder outputs; hum-free (DC on all tube filaments). Exclusive printed-circuit switches and boards. Custom styled case, 4¼ x 13 x 8". Shpg. wt., 17½ lbs.

Model Y-776. Net only $62.50

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Absolutely the finest dual amplifier you can build—equal to highest-priced factory-built units. Ideal for use with the KNIGHT-KIT preamp, either as two 30-watt stereo amplifiers or 60-watt monaural amplifier. Exceptional response from 10 cps to 42,000 cps. Phenomenal 0.08% distortion at full 60 watts. Includes static plate current balancing adjustments for each channel; absolute stability under all operating conditions; custom-quality transformers. Also has special built-in circuitry, with easy external adjustment, for precise balance of gain on each channel to achieve perfect monaural performance. Two printed-circuit boards for easy assembly. Beautiful black and chrome; 9 x 14 x 8¼". (Less cover.) 36 lbs.

Model Y-777. Net only $84.50

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Y-779. Gray metal cover. 4 lbs. Net.... $6.50

Deluxe FM-AM Hi-Fi Tuner Kit

The best-looking, best-performing FM-AM tuner kit for the money. You'll enjoy building it; you'll be proud of its performance and beauty. FM sensitivity is a remarkable **2.5 microvolts for 20 db of quieting.** AM is 3 **microvolts for 10 db signal-to-noise ratio.** Outstanding features include: single large printed-circuit board with most critical wiring already done; AFC (with disabling feature); flywheel tuning; precisely pre-aligned RF and IF coils—no further alignment needed; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; rotatable built-in AM antenna. Beautiful French-gray case, 4¼ x 13¼ x 8". Ready for interesting easy assembly. Shpg. wt., 12 lbs.

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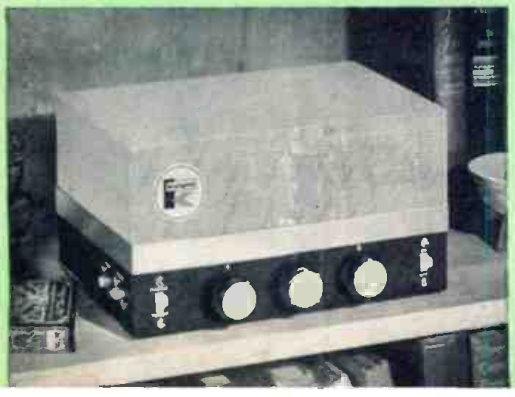
KNIGHT-KIT hi-fi components, as easy to look at as they are to assemble, are professionally designed to take their place alongside the finest of home furnishings. You'll be proud of your finished work.



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Never before has there been so much solid hi-fi value and quality performance at such low cost. Features smooth, clean output for truly rich reproduction. **Guaranteed specifications:** frequency response, 30-15,000 cps ± 1½ db at half power; less than 1% distortion at full power. Has **15 db of inverse feedback.** Has preamp stage equalized for magnetic cartridges; inputs for phono and tuner; separate bass and treble controls with both boost and attenuation, push-pull EL84 output tubes; virtually hum-free performance. Handsomely styled to look well anywhere; size with cover, 5 x 9¾ x 7". 7½ lbs.

Model Y-784. 12-Watt Amplifier Kit, less cover. Net only $19.95

Y-783. Attractive French-gray cover for above. 3 lbs. Net only .. $3.95

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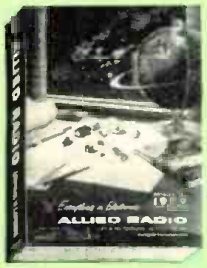

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For full descriptions of the KNIGHT-KITS below, see the 452-page 1959 ALLIED Catalog. If you haven't a copy, send for it today—use coupon on following page.

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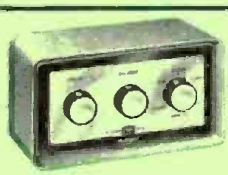
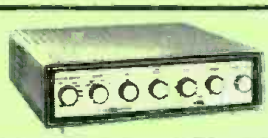


Universal Stereo Control Kit

Provides full centralized stereo control (volume, balance and channel selection) for use with any two amplifiers. Handles up to 20 watts program material. Unit simply connects between speakers and output terminals of amplifiers (no amplifier rewiring needed). Lets you balance speaker system volume; provides master gain control for overall volume (can be used remotely); lets you play either channel monaurally through one or both speakers; provides channel reversal; phase reversal switch for best overall performance. 4½ x 7¾ x 4". 3½ lbs.

Model Y-778. Net only ... **$9.95**



Deluxe Hi-Fi Preamplifier Kit

Quality audio control center. 16 combinations of equalization; 8 inputs including tape head; DC on all tube filaments; printed-circuit switches and boards. Custom-styled. 12½ lbs.

Model Y-754. Net only **$39.95**

25-Watt Hi-Fi Basic Amplifier Kit

Williamson-type circuit. Response, ±0.5 db, 9-70,000 cps at half power. Includes balance control; calibrated damping control; potted output transformer. Shpg. wt., 25 lbs.

Model Y-793. Net only **$44.50**

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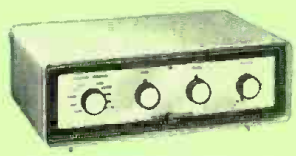

18-Watt Hi-Fi Amplifier Kit

Superb hi-fi specifications; deluxe custom styling. Includes 8 inputs for every desired signal source; full equalization; printed-circuit switches and boards for easy assembly. Shpg. wt., 15 lbs.

Model Y-797. Net only **$39.95**

30-Watt Hi-Fi Amplifier Kit

Linear-deluxe Williamson-type circuit. Clear, rich 30 watts output; full equalization; 8 inputs; level and loudness controls; DC on filaments of preamp tubes; rumble filter; variable damping. Exclusive printed-circuit switches and boards. Custom-styled. 32 lbs.

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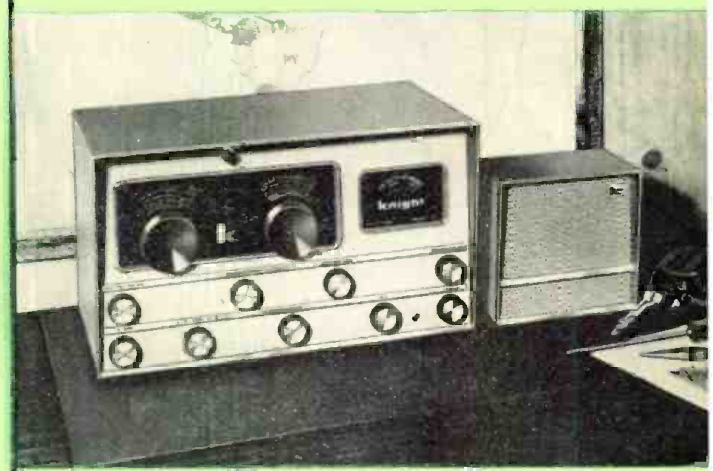

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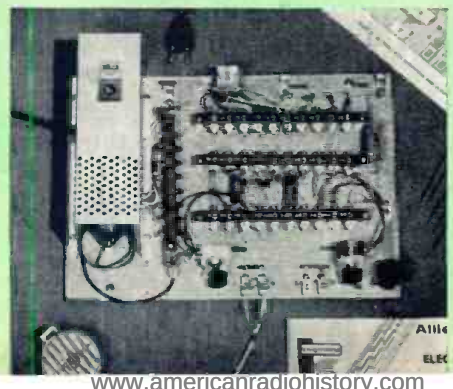

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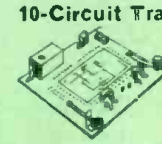

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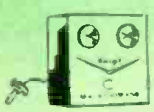

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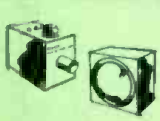

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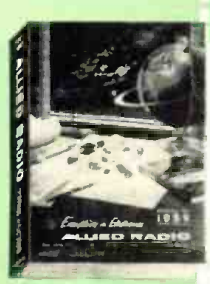

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Industrial Tubes

(*Continued from page 40*)

radio engineering field. In the process of developing insulators for the high-frequency conductors used in radio transmission, the insulators became very hot despite the fact that they were poor electrical and thermal conductors. Investigation revealed what proved to be the basic theory behind dielectric heating.

To simplify the explanation, we will translate the high-frequency conductor into a parallel-plate capacitor with the insulator as the dielectric material between the plates. When voltage is applied to the plates of the capacitor, the electrons in the insulating material are attracted towards the positive plate while the atomic nuclei are attracted toward the negative plate. Both reactions occur simultaneously and are accompanied by an energy conversion which is manifested as heat. If the voltage polarity applied to the plates is reversed, the electrons and nuclei will also reverse direction and produce more heat. As the frequency of polarity reversal increases, so will the amount of heat produced.

Unlike induction heating, dielectric heating reaches all parts of a homogeneous material equally. In fact, because heat can escape faster from the surface of a work piece, it is possible to have higher temperatures at the center. One case is reported where the center of a 2-inch thick plywood board was actually charred while the surface was unmarked. This characteristic involves both advantages and disadvantages; the thorough, rapid heating is a definite advantage while the necessity for careful control and possible reduction of power input is a disadvantage.

We are now in a position to look at some of the uses for dielectric heating. The largest areas of application are moisture removal, wood gluing and laminating, plastics processing and sealing, and food processing. Although the materials handled in these areas are obviously different, they all have one characteristic in common; each and every one of them is a poor thermal conductor. In fact, it is the ability to heat materials which are poor thermal conductors that makes dielectric heating such an important industrial tool.

For instance, consider the problem raised when wood pulp is shipped from the mill to the paper plant. Since wood pulp consists of wood fibers in a water solution, a significant percentage of the shipping costs is for hauling water. Naturally a solution to this problem would be to eliminate the water before shipment and put it back in at the paper plant. But how? The conventional equipment to handle this job would be both enormous and expensive. On the other hand, a 20-kilowatt dielectric heater (size about 6 x 4 x 4 feet) will remove one pound of water per minute at room temperature with a power input of only 40 kilowatts per hour. In addition, the dielectric heater raises the temperature of the water at a much faster rate than the wood fibers, thus the fibers remain relatively cool and unharmed. Conventional methods do not have that safety feature.

One of the most attractive features about dielectric heating is its relatively low-power requirements. Not

Table 2. Power and frequency ranges of industrial equipment discussed in text.

PROCESS	FREQ. RANGE[1]	APPROX. POWER[1]	APPLICATIONS[2]
Induction Heating	10-500 kc. or more	25 kw.	Small soldering and welding units
Dielectric Heating	1-500 mc. or more	2 kw.	Restaurant ovens ("Radarange")
Ultrasonics	20-30 kc.[3] or 400 kc.	1 kw.	Clothes and dish washers, small industrial cleaners

NOTES: 1. These are most popular ranges. See text for other ranges; 2. Immediate areas of opportunity for the technician starting now; 3. 20-30 kc. for magnetostriction transducer, 400 kc. for piezoelectric.

Table 3. Listing of heating times and power requirements for solder operations.

PROCESS	HEATING TIME (sec.)	POWER REQUIRED (kw.) steel	brass	copper
Soft Soldering at 370°F (per in.^{2} area)	20	2.0	4.0	8.4
	40	1.0	2.4	5.5
Silver Soldering at 1300°F (per in.^{2} area)	20	8.0	16.0	33.6
	40	4.0	9.6	22.0

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only is it a very efficient source of heat, but it uses considerably less floor space than an equivalent conventional source. For example, the most commonly used generator is the 2-kilowatt model which is about equal in size to a modern TV console—a relatively small package for the heat produced.

Ultrasonics

Ultrasonics is concerned with the use of mechanical vibrations at frequencies above the audible range. The difference between audible sound and ultrasonics lies only in the ability of the human ear to respond. Many ultrasonic generators operate between 20,000 and 30,000 cps while some operate as high as 400,000 cps.

The equipment consists of an electronic generator of high-frequency energy and a transducer to convert the electronic oscillations to mechanical vibrations. The generator is simply a power oscillator and is very similar to the induction and dielectric heating generators. The transducer is a device that converts electrical energy to mechanical energy. An ordinary loudspeaker is one example of a transducer. This transducer uses air as the medium being operated on while the medium used for most ultrasonic transducers is a liquid, frequently water. The ultrasonic transducer is in direct contact with the liquid and either produces "cavities" in the fluid or waves, which travel through the liquid without disturbing it. As the holes or cavities in the water collapse, a turbulence is created which provides a gentle, effective scrubbing action. The scrubbing is so effective that it will even remove radioactive particles and yet it is gentle enough to clean a delicate missile control while it is still assembled. Cleaning is the largest industrial application for ultrasonics, although ultrasonic drills and soldering irons are also used.

There are many applications for the non-violent ultrasonic waves. The largest application in this category is underwater detecting equipment, such as sonar, depth indicators, and fish finders. Other uses are for liquid level sensing, non-destructive testing, and gauging.

Of the three high-frequency industrial applications, ultrasonics has the lowest power consumption. The most popular size is 1 kilowatt and some recent applications use less than 200 watts. The lower-power equipment is portable, being not much larger than a table radio.

Conclusion

Now that we have had a brief look at some industrial uses for electronics, we can get a small idea of the immensity of the field. We can see that there are a good many uses for electron tubes that are not directly related to consumer products, such as radio and TV receivers. The technician who wants to expand his scope would certainly do well to learn as much about these applications as he can. —30—

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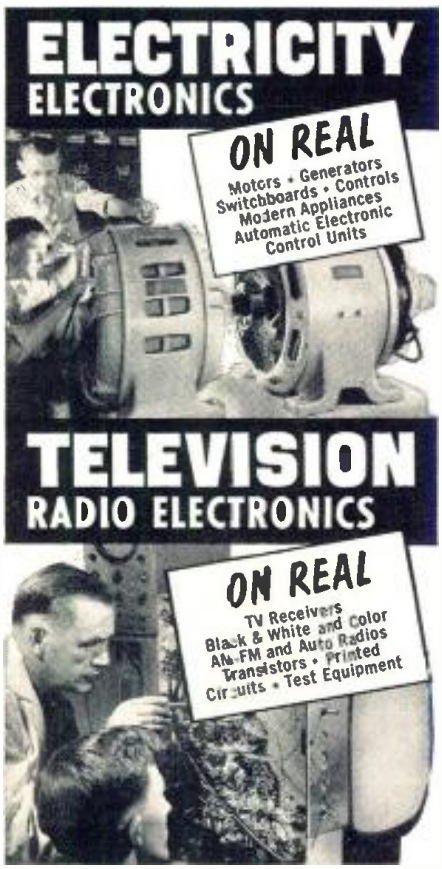

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Service Association of the Month

ASSOCIATED RADIO & TV SERVICEMEN OF ILLINOIS

ALTHOUGH not a large group in terms of numerical strength, ARTS of Illinois has made its presence felt on more than one occasion since its inception six years ago. The circumstance of its birth centers about an effort being made at that time to get service-licensing legislation approved by the Illinois state legislature.

Howard Wolfson, a small, independent service dealer in Chicago who is now ARTS chairman, had little to do with association activities up to that time. However, he had deep convictions concerning the regulation of business by government. He felt that TV service licensing, to begin with, was discriminatory. With a long tradition of unfettered operation of those engaged in service and repair, whether it be of watches, autos, washing machines, or anything else, singling out of the TV technician for control would be to make him a scapegoat. In any case, interference from government could only bring harm to the industry, which must look to other approaches for the solution to its problems.

Disturbed over the threat he felt licensing to be for TV service, Wolfson began to contact other dealers in the state, by telephone, by mail, and in person, to let them know about the proposed legislation and to sound them out on their own attitudes. The group of like-minded dealers he got to join with him at that time to work for the defeat of the bill formed the basis for ARTS. The group stands today, along with such other groups as TEAM of St. Louis, as a leader in the fight against any licensing as being repressive, restrictive, and discriminatory.

ARTS relies heavily on the power of communication. It keeps in contact with many other groups in all parts of the country on matters of mutual concern. It played a key role, for example, in the formation of the American Electronic Alliance in 1958, and again in the more recently formed Midwest Electronic Alliance. Although its stand on licensing and other basic issues has kept it from affiliating with NATESA, it has worked with many local groups in and out of that national body.

"Back-door" selling by jobbers and bait advertising have been some of its targets. In connection with the latter, it has been one of the groups that have actively cried out against ads in telephone directories by service establishments that use such gimmicks as "free estimates" and "free service calls." Publishers of the directories and the telephone companies have agreed with the complainants that such advertising is not in the public interest and have stated that they will discourage it.

On the technical side, ARTS conducted one of the first color training schools for service in the midwest in 1954. It is now conducting a similar technical series on transistors.

Elected annually in September, its officers now include Howard Wolfson, chairman; Joseph Ehlinger, vice chairman; Yuki Minaga, secretary-treasurer; George Neize, sgt.-at-arms; Anthony Mallin, historian; and John Sotor, public relations. Its 30-odd members are all full-time service business men with full-fledged establishments. Located at 433 S. Wabash Ave., Chicago 5, Ill., it issues its publication, "Common Sense," on a rather individual schedule. This mimeographed paper does not have a regular publication date: it comes out whenever its members have something to say.

ARTS feels that the industry will prosper through the constant education of shop owners, technicians, and the public. —30—

Would you like us to feature your association here? Send in the coupon!

Service Editor
RADIO & TV NEWS
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We want to tell you more about our association. Please send us your questionnaire.

Name of Association.....

Mailing Address.....

.....

Name of President or Corresponding Sec'y.....

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Service-Business Problems
(*Continued from page* 50)

their percentages of call-backs by taking more time to check and analyze each set. Other dealers keep a close check on the stability of tubes by brands and types and standardize on those that show up best in performance and reliability.

A serious problem that confronts all dealers—large and small—is the relatively low wage scale for TV technicians employed in the independent service industry. The U. S. Department of Labor, through its Bureau of Apprenticeships, has shown a keen interest in helping to develop standards and apprenticeship-training courses for TV technicians. Most of this effort will be lost to the independent service industry unless dealers generally give serious thought to the adoption of service pricing schedules that are commensurate with the actual costs of operating in today's market.

The endless demands on the time of all people who operate small businesses make bookkeeping, cost accounting, and analysis a chore they must fit into the odd moments they can snatch between doing other things. Since accurate records are the only "road maps" a dealer can have to show him where he is headed business-wise, slipshod record-keeping often greases the path to failure. Excellent bookkeeping services are now available everywhere at a very nominal cost and many dealers have turned this specialized function over to them.

Old customers, who are the mainstay of many small service businesses, often pose a serious credit problem. How to collect a service bill from a slow-pay old customer without offending him is a problem that stymies many. Since the bulk of service work of all types is now handled on a strictly COD basis, a dealer faced with a lot of old customer-credit business could profit from the use of some of the standard collection systems now available that nudge slow-pay accounts without offending them.

At the end of our list of service management problems, we come to the accumulation of completed service jobs which, for one reason or another, customers have not picked up or paid for. These are comparable to the "layaway" headaches the average retailer finds piled on his shelves. on which the customers have paid inadequate small deposits. Numerous plans have been developed to anticipate such delays, to collect in advance for the time involved in handling the work, and to get customers to pick up the sets promptly after completion of the work. These will be covered in a future article.

This, in brief form, covers ten of the current top problems faced by managers of electronic service businesses. They will be discussed in greater detail in subsequent issues. —30—

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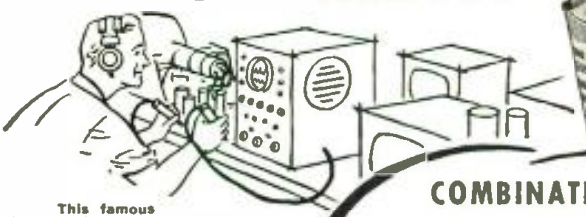

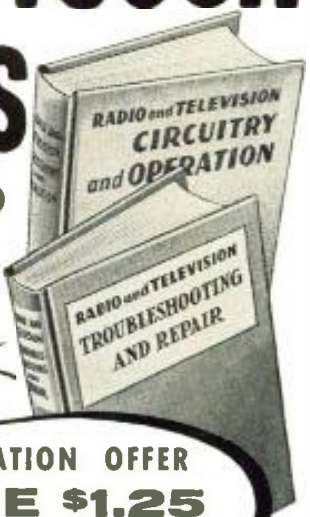

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Test Bench PUZZLER: No. 4

By **WAYNE E. LEMONS**

The a.g.c. played hide-and-seek only with the set in the cabinet—but the cause was really simple!

THIS DEFECT was simple—after we found it. Most of them are. The symptoms were loss of sync and improper a.g.c. action, with a capricious addiction to a sort of motorboating instability. The latter indication was much like that encountered on this KCS103 and other *RCA* receivers when the stability or noise-limiter control is misadjusted.

Some rough cases leave you swearing at the service business in general. This was one of them. In addition to being intermittent, it was also temperamental, obstinately refusing to show up except when the chassis was inside its cabinet with all screws inserted *and* tightened!

We began by checking the a.g.c. voltage at the tuner (a convenient terminal), where practically none was found. Rotating the a.g.c. control had no effect. Next, using a socket adapter, we shorted the grid of the a.g.c. keyer tube (point 1 in the diagram) to the cathode. Since this zero-biased the keyer, it should have produced maximum conduction of this stage, if the keyer were operating properly, with a high negative voltage on the a.g.c. line as a result. This step did produce an appropriately high negative voltage. In that case, we reasoned, the keyer was not getting proper conduction bias.

Using the socket adapter again—and holding our breath, hoping the set wouldn't decide to start working normally again—we checked voltage at the plate of the 6AW8A video amplifier, point 2. The reading was below the normal 122 volts expected here. The tuner was then switched off-channel. The change in plate potential at point 2 produced by this switch was less than five volts. This could mean a high resistance in the plate circuit of this stage or inadequate grid bias.

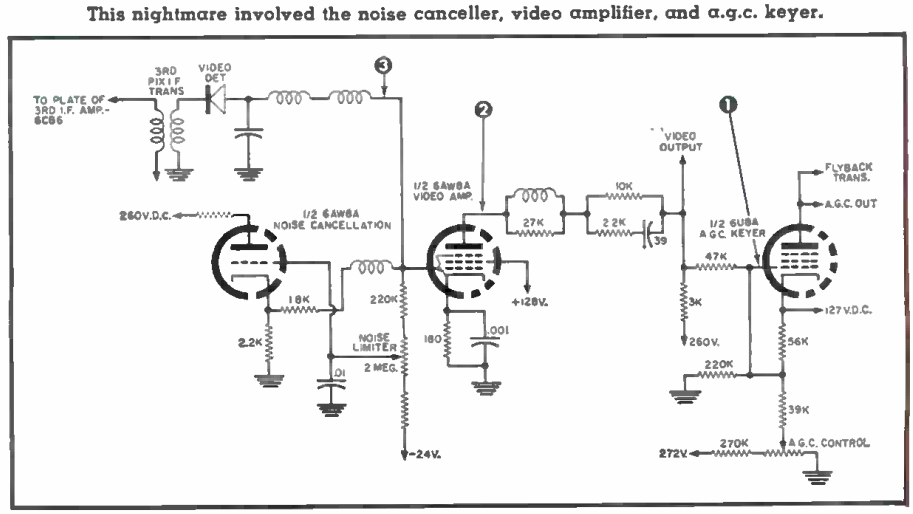
In this circuit, which is shown here in simplified form although no important elements have been left out, the video amplifier grid is biased directly by the germanium-diode video detector. Thus a stronger signal will normally cause the grid to go more negative. Measured with a strong signal coming in, the grid voltage was about −2.5 volts. With the receiver switched off-channel, there was practically no change in this reading.

Now convinced that the diode itself was defective, we made a resistance check from the grid of the video amplifier (output of the detector, point 3) to ground. 4000 ohms was measured one way; with the ohmmeter leads reversed, the reading was 2500 ohms. Since this seemed like the trouble, the chassis was pulled from the cabinet, the diode was replaced, the set was restored to the cabinet, and turned on. It worked—for almost an hour. Then, the same symptoms appeared.

A re-check of the set brought us right back to the detector, where readings were as noted earlier.

You have all the facts available to the service technician before he finally won his bout with this dog. What do you think the trouble was? In case you're getting ideas, it was not *a case of the replacement diode being as bad as the original. As the author states, it was really a simple thing. However, if you've had your share of rough jobs for the day, you can get the answer quickly by turning to page 156.*

This nightmare involved the noise canceller, video amplifier, and a.g.c. keyer.



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on 6.248, 9.833, 11.910. (Bellington, N. Y.)

FBS, Middle East, Malta, now signs on 2330 on 7.22, 6.14, and 6.015; off 0200. (Bellington, N. Y., Stark, Texas, others)

Lisbon noted on 15.38 and 11.04 opening 1230; off 1530 and back at 1600; final daily sign-off is 1800. (Bellington, N. Y.)

At press time, Moscow was announcing its evening transmission for North America, 1820-2300, on 15.23, 11.89. 11.82, 9.67, 7.29, 7.25. (Fargo, Ga.) Same data received direct from *Radio Moscow*. (Schilling, Calif.)

Radio Douala, French Cameroons, in verifying listed frequency of 7.287, 1 kw. (Peddle, Newfoundland) *ISWC,* London, says is now using 7.287 and 9.150 in parallel daily 1230-1515.

Lusaka, Northern Rhodesia, 3.914 and 7.220, noted 0900-1230; has *English* on Sundays and Tuesdays 0400-0600. ZRB, 9.110, Pretoria, South Africa, is scheduled 2345-1015. V3USE, 15.055V, Mauritius, is again audible in the United Kingdom around 1100; closes down 1230 with "God Save the King." (ISWC, London)

Schedules just in from *Radio Pakistan* list news for 2100 on 9.645, 15.335; 0110, 15.270; 0210, 11.885, 15.270; 0700, 11.885, 11.570; and 1015, 9.645, 11.570. (Dary, Kans.)

Radio Sweden's winter schedule is 1900-2030 on 6.065, 10.780; 0015-0235, 6.065, 10.780; 0235-1015, 11.705, 15.155; 1015-1300, 10.780, 15.155; 1300-1330, 6.065, 10.780; 1330-1400, 10.780, 6.065; 1400-1700, 10.780, 6.065; DX session is Saturdays 0215, 1015, 2015; stations are SBO, 6.065; SDB2, 10.780; SBP, 11.705, and SBT, 15.155.

* * *

Acknowledgment

The winter DX season is off to a good start! Please keep your reports coming—from anyone, anywhere in the world—to 948 Stewartstown Road, Morgantown, West Virginia, USA. Thanks! . . . . . KRB.

AMATEUR TV STATION IN CANADA

ON September 1st, a complete TV transmitter, using equipment designed by J. R. Popkin-Clurman, W2LNP and described in the May, June, and July 1950 issues of RADIO & TELEVISION NEWS, was set up at the home of John D. Woodlock, VE2HE in Iberville, Quebec, approximately 28 miles north of the United States border and 32 miles from the city of Montreal.

The equipment was on the air continuously from September 1st to 5th putting out a test pattern and pictures. Propagation tests were made using this equipment. The carrier frequency was 53.51 mc. (6 meter amateur band) and standard television receivers, slightly modified by shifting the local oscillators down from Channel 2, were used for field tests. The transmitter radiated 25 watts peak and was fed into a "Vee-D-X" Type RD-13-A array which was rotatable. Effective radiated power was estimated at 250 watts.

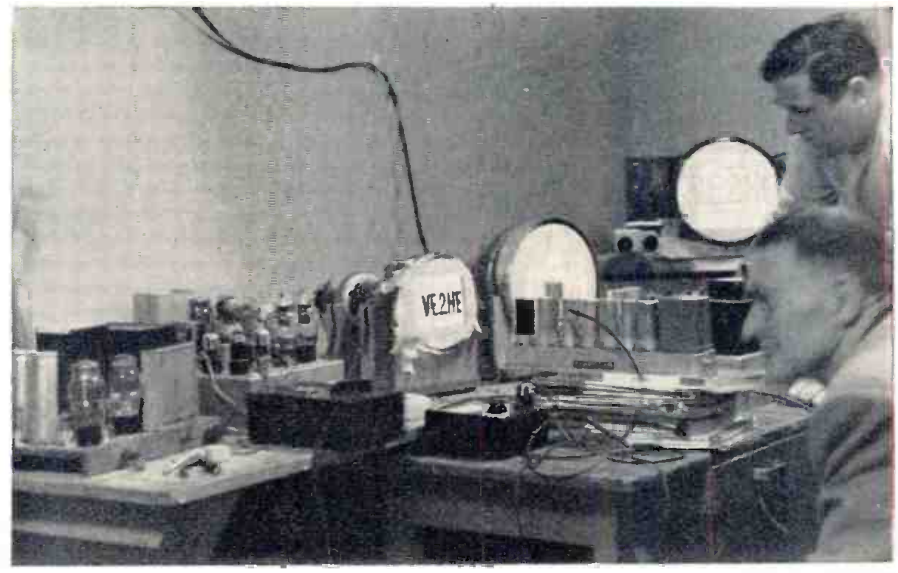
Strong signals were received at Lacolle, Quebec by VE2AMO, 21 airline miles away and at several places in the city of Montreal, about 32 miles away. The blanking bars were received at Lavaltrie, Quebec at the station of VE2SV, approximately 51 miles distant, with a faint picture being seen.

A receiver was set up at the home of VE2JN in St. Johns, Quebec, and a program transmitted for his benefit. Others participating in this series of television tests were VE2WF, VE2AEZ, VE2SG, VE2RC, VE2AG, VE2LQ, and C. M. Berry of Montreal and O. Fontaine. The effective resolution of the pictures up to 8 miles was better than 325 lines. VE2HE expects to start TV transmissions again within a month, probably with higher power.

Since September 8th, the transmitter has been on the air with test patterns and has been received in many of the suburbs of Montreal with good picture detail.

-30-

John D. Woodlock (right foreground) checking operation of his ham TV setup. Since this original item was written, word has been received that Mr. Woodlock died suddenly in his sleep on October 31, 1950 at his home in Iberville, Quebec, Canada.



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Thyrite Resistors

(*Continued from page 51*)

with the top output terminal positive as shown in 6D. As the applied voltage is lowered from the value required for null, the output voltage will reverse polarity and increase to a maximum in the opposite direction.

This circuit has two useful applications; one as a polarity-reversing control circuit, the other as a voltage regulator. Operation as a control circuit results from the action just described. The output voltage of reversing polarity, produced by changes in value of the input voltage, may be applied to polarized relays or to thyratron grids. Voltage regulator action is obtained when the applied voltage is somewhat more positive or more negative than the value required for bridge null. Under these conditions, output voltage changes will be a small percentage of supply voltage changes. The closeness of voltage regulation will depend upon the *Thyrite* exponent (See Equation 1).

Fig. 6E shows a potentiometer (voltage divider) in which the load taps are taken between series-connected *Thyrite* resistors. When the load currents are small with respect to the current flowing through the *Thyrite* string, the load voltages will be fairly constant. Variations in load voltage resulting from variations in load current, while not entirely eliminated, are much lower with the *Thyrite* potentiometer than with a conventional unit using linear resistance sections.

A simple voltage regulator is shown in Fig. 6F. The ratio of linear resistance (R) to *Thyrite* resistance (T) is chosen such that the *Thyrite* resistor operates within the steepest portion of its volt-ampere characteristic. Large changes in *Thyrite* current, resulting from corresponding changes in applied voltage, accordingly will produce small changes in voltage drop across the *Thyrite* resistor. Since output voltage is taken across the latter, output variations will be a fraction of supply voltage changes. The effectiveness of this regulator is enhanced when the output load current is small compared to current flowing through the *Thyrite* resistor. A particular advantage of the circuit is its ability to regulate alternating, as well as direct voltages.

The effectiveness of the voltage regulator may be increased by cascading several sections, as shown in Fig. 6G. Variations in the output of each section are a small percentage of variations in the voltage applied to that section. As the number of sections is increased, the output voltage variation accordingly approaches zero. However, each regulator section attenuates the initial applied voltage, as well as the voltage variation. The practical limit to the number of cascaded sections which can be used in a particular case is determined by the

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SURPLUS RADIO CONVERSION MANUAL NO. 2 containing conversion information for GO-9 to 10 meters and 110V 60 cycles. Contains 18 other popular conversions and complete information $2.50

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BC-906 ABSORPTION-TYPE FREQ. METER

Freq. range 150-225 Mc. Uses 0-500 OC Microammeter for indicator. In black crackle carrying case with handle. 12½x8¾x6½". Net 18 lbs. With tubes and calibration chart. New $14.95

BC-221 FREQ. METER $72.50
BC-221 AK Modulated Freq. Meter... $92.50
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8-25	Stancor	300	80	5.95	5KV	Open	8½
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12	Thordarson	375	105	3.95	5KV	Closed	8
12	Thordarson	400	400	6.95	2KV	Closed	15
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20	Stancor	300	80	4.95	3KV	Closed	9 lbs.
20	UTC	300	90	4.50	4KV	Closed	10 lbs.
20	UTC	400	85	5.95	5KV	Closed	14 lbs.

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amount of voltage reduction which can be tolerated.

The circuits of both 6F and 6G may be employed as signal limiters ahead of, or between the stages of a tube amplifier. Such limiters differ from clipper circuits in that they keep the signal amplitude reasonably constant without squaring the wave. However, the odd-harmonic distortion introduced by the *Thyrite* must not be neglected.

The circuit of 6H may be considered the inverse of the voltage regulator (Fig. 6F). Here, the non-linearity of the *Thyrite* resistor is used to multiply variations in the applied voltage. It should be noted that it is only the *variation ratio* which is multiplied by this circuit, and not the voltage itself. Actually, the input voltage is attenuated, although the ratio of change is increased in the output. The ratio may be increased still further by additional sections in cascade, as shown in Fig. 6I. The practical limit to the number of sections which may be added is set by the permissible amount of voltage reduction. For best results, circuits 6H and 6I both should operate into high-impedance loads. Also, the linear resistances (R) must be small in comparison with the *Thyrite* resistances.

Operating Data

The following properties of *Thyrite*, which are of interest to circuit designers, are quoted directly from *General Electric Bulletin GEA-4138B.*

(1) *Electrical Stability.* (a) No change with time. (b) With proper application, *Thyrite* can be operated indefinitely without change in characteristic. (c) Unaffected by pressure or vibration. (d) Has same characteristics for impulses of microseconds duration as it has for d.c. or a.c. instantaneous values of current and voltage. (e) Free from polarization effects.

(2) *Power Ratings.* (a) *Continuous.* Depends upon permissible temperature rise of *Thyrite* and provision made for dissipation of heat. A continuous rating of 0.25 watt per square inch of *Thyrite* surface is usually allowable for separated discs, with the plane surfaces vertical, in still air. This conservative rating can be increased, where necessary, by the use of special provisions for cooling, such as radiating fins, forced-air draft, or immersion under oil, or *Pyranol.* (b) *Short-time.* Short-time rating depends on volume of disc. Assuming no time for radiation, a temperature rise of 80 C. results from energy input of 2000 watt-seconds per cubic inch of *Thyrite.*

(3) *Effect of Temperature.* An increase in *Thyrite* temperature tends to increase the current, the increase in current also being dependent upon the voltage applied. The change in resistance at constant voltage is from —0.4 per-cent to —0.73 per-cent per degree C. over the temperature range 0 to 100 C. To avoid undue oxidation of

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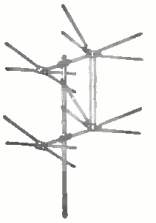

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the metallized surface and to preclude depreciation of impregnating compound, the operating temperature of *Thyrite* should not exceed 110 C. continuously, nor exceed 150 C. for short times. However, proximity of *Thyrite* to other materials may dictate lower operating temperatures.

(4) *Effect of Humidity.* Effect on *Thyrite* volt-ampere characteristics is minimized by use of impregnating compound. At currents below one milliampere, and for high-humidity conditions, further precautions may be necessary.

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The author has consulted the following references and recommends them to readers desiring a more extensive treatment of *Thyrite* characteristics and applications.

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-30-

BYPASS REPLACEMENT

By L. FLEMING

A COMMON failure in transformer-operated TV receivers, such as the Philco Model 48-1000, is the shorting out of the 0.1 μfd. paper bypass condenser connected between ground and the screen of the horizontal deflection output tube. When this condenser shorts, it places the full "B" supply voltage across the screen dropping resistor, which is usually a carbon unit of around 2000 ohms. The result may be smoke, smells, and burned-out 5U4G rectifiers.

An overheated carbon resistor tends to go down in resistance, rather than up, so that the overloaded dropping resistor becomes practically a dead short across the plate supply. The failure is just the opposite of a "safe" failure. The usual fuse protection against excessive plate current in the 6BG6G tube is of no help, because the short is external to the tube.

This type of failure can be made "safe" by using one of the new metallized paper condensers for the screen bypass replacement. The self-healing characteristic of metallized paper is just the thing for this application. According to the manufacturers, if one of these condensers breaks down, the resulting arc discharged through the paper dielectric removes the weak spot in the paper and at the same time vaporizes the metal film around the spot, clearing the fault.

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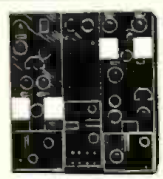
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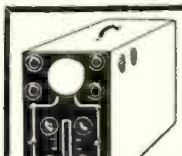
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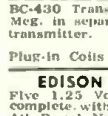
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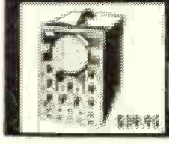
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RADIO-TV Service Industry News

AS REPORTED BY THE
TELEVISION TECHNICIANS LECTURE BUREAU

THE crystallization of a plan that was launched in Chicago in September by a group of Chicago television service contractors occurred at a conference held in Washington in late October. At this meeting, which was attended by service representatives from many sections of the country, the *National Alliance of Television and Electronic Service Associations* (*NATESA*) was formed. The general plan for the operation of the national federation was agreed upon and a slate of officers selected.

Frank J. Moch, the dynamic president of the *Television Installation Service Association* of Chicago, was chosen president of the new organization. Albert M. Haas, president of the *Television Contractors Association of Philadelphia* was named vice-president, while Jim Hustad of the *Omaha Television Installation Service Association*, Omaha, Nebraska, was named secretary. The duties of treasurer will be handled by Bertram L. Lewis of the *American Radio Technicians Guild of Rochester* (N. Y.)

The philosophy and purpose of the *National Alliance of Television and Electronic Service Associations* is outlined in a letter from Mr. Moch to the editor of your *"NEWS"* department:

"NATESA was formulated to give the service profession an equal footing with the rest of the industry. We are certain that this new national group, when it is given its rightful place at the council tables of the industry, can do a great service for the entire industry.

"As President of both *TISA* and *NATESA* I am pledged, as I have always been in the past, to achieve full stature for the service profession. I am certain that such a goal can be reached very soon. Many conferences have already been held with other elements of the industry; many others are scheduled for the near future. One of the cardinal principles of *NATESA* is that it will not be a 'racket.' It will be

What's the best fringe area antenna—Yagi, conical, circle, or ian? Norman L. Chalfin answers questions for a group of Akron technicians at a recent service lecture session.

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operated by service people. It will work unselfishly to the end that service will be recognized not as a necessary evil but as a very essential, integral element of the industry.

"NATESA will adopt a code of ethics and an emblem which will be the symbol of competence to the public. It will vigorously prosecute any service racket from without or within the profession. Among its goals will be:

1. Recognition of service as an honorable element of the industry.
2. The establishment of standards.
3. The establishment of "post graduate" training.
4. The establishment of adequate compensation for personnel and management.
5. A place on industry's councils."

Organizations that want to contact *NATESA* should address their letters to: Frank J. Moch, President *NATESA*, 5908 South Troy Street, Chicago 29, Ill.

Manpower Situation

Government agencies, the Armed Services, and the television and electronics manufacturers are taking experienced field service technicians at a quickening rate. While the most serious inroads on the ranks of experienced service personnel have occurred in the metropolitan areas its effects are being felt by the service industry throughout the country.

The seriousness of the situation is clearly reflected in a frank "open" letter recently released to the leaders of the television industry by Albert M. Haas, president of *TCA* in Philadelphia.

"In Philadelphia the picture is clear: The loss of service technicians in television to the Armed Services and to the manufacturers of television and electronic equipment has become appreciable. Service calls are now being handled in five days instead of 24 hours because there just aren't enough technicians to handle them!

"Reports from members of this association indicate that the spread in service time will become wider unless something is done to forestall it. Published reports in trade publications confirm that Philadelphia is not alone in this predicament; other television centers report that their situation is even more alarming."

That this situation will become extremely critical was further evidenced in a talk given by E. C. Cahill, president of the *RCA Service Company*, before a group of 200 technicians at the Electric Institute of Boston. Mr. Cahill pointed out that an additional 10,000 television service technicians are required to handle the installation and service of the current television production output of the industry.

Citing the incredible speed of television's growth as one factor in the expanding need for trained service personnel, Mr. Cahill pointed out the complications posed by the fact that it takes years to train a technician to full competence while the present field forces are being skimmed off by gov-

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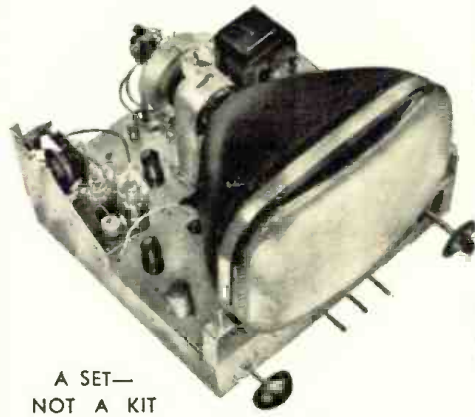

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A group of Akron technicians take a breather between lectures presented by the Lecture Bureau in a recent Radio-Television Service Industry Day program in that city. From left to right are: W. O. Parsons, East Akron Radio Service; Bill McPherson, Medina Radio & TV; John Ablett, Mac's Radio Service; and Mike M. Strboya, Medina Radio & TV.

ernment agencies that are drawing heavily on the service industry for technicians for top priority work.

The statistics given in Mr. Haas' "open letter" are helpful in getting a clear picture of the problem:

"We understand that there are about 60,000 qualified electronics experts engaged in television service. This means that we have one man to handle 167 sets of the ten million now said to be in operation.

"Without losing any of these men the service job involved in keeping ten million sets functioning, aggravated by the parts and tube shortages, is staggering. For each man to handle the service on an average of 167 sets, under today's conditions, is impossible. The line has to break somewhere under the pressure."

But despite the known and widely recognized seriousness of the situation no industry plans of any kind have been advanced toward solving the problem. In a few cities like Philadelphia and Chicago, where strong, active service organizations are operating, steps are being taken to put into operation planned programs to utilize the available personnel most efficiently. But these local programs cannot solve the pressing problem of manpower depletion. The problem cannot be solved by the service industry alone.

The real solution lies in some aggressive, soundly-conceived industry-wide program that will take into account the technical manpower needs of all segments of the industry and operating under a plan that will capture the interest of more men and women in this great new opportunity that is Television.

Parts Problem Serious

The service industry seems to have acquired "Trouble" as its stepmother in these arduous days. Another facet of the problem of providing satisfactory service is the difficulty in getting replacement tubes and parts.

Many manufacturers continue to sell the "tied-in" 12-month parts warranty contracts which, in the face of their in-

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ability to meet replacement commitments on previous contracts for the past several months, will have some very unfavorable repercussions unless distributor "pipelines" are soon filled with the necessary replacement supplies.

At the beginning of this period of shortages practically all service operators accepted distributor "due bills" for tubes and parts replaced under warranties and used parts and tubes from their own stocks. However when it became evident that their own stocks soon would be depleted leaving them holding the bag on the parts' investment and without supplies to take care of their growing COD business needs, service contractors found it necessary to take drastic protective action.

TISA of Chicago advised its members: "In the case of inability to get a replacement part on "in warranty" sets, advise the customer that the parts replacement is the sole responsibility of the manufacturer and his distributor since the factory collected the parts fee. If you have the part available in your stock, use it in the set if the customer so requests, however, charge the customer full list price for the part and return the defective part to him with the instructions that he return it to the distributor otherwise a long delay will result."

And *TCA* of Philadelphia stated its position in a letter to the manufacturers of television receivers and their distributors in the Philadelphia area: ". . . this association has gone on record (10-19-50) as advocating that all contractors charge the customer for the replacement of parts in warranty and to advise the customer that he should take up with the manufacturer the replaceability of the affected parts and reimbursement for any parts provided by the contractor.

"We are impelled by the urgency of the present parts situation to take this step, much as we regret it. It is our hope that the manufacturers will take whatever steps are necessary to reduce the urgency and permit us to function in our accustomed role. When that happens we will be most happy to cooperate with the manufacturer in maintaining the customer's enjoyment and appreciation in his television receiver."

Before the present serious international situation developed the manufacturers of tubes and components were months behind in meeting the growing needs of the industry. They were allocating definite percentages of their production for distribution through regular replacement parts channels. Although the independent parts distributing pipelines were adequately stocked on most replacement items they were not overstocked.

The war-scare buying that boomed television and radio sales during the normally light summer months sent many set manufacturers scurrying into the replacement parts field to buy additional supplies of the components they needed to increase their set pro-

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duction. Several receiver manufacturers shipped tubeless television receivers to their distributors with instructions to pick up the necessary tubes from an independent parts distributor.

In the light of these developments it appears that receiver manufacturers have concentrated on the production of complete receivers without regard to their obligations to supply adequate stocks or replacement parts to maintain these receivers in service. Perhaps their thinking is based on a gamble that the normal post-Christmas buying letdown will slow sales and permit the replenishment of distributors stocks of tubes and parts. It is a gamble all right. It is a gamble against a rising crescendo of customer complaints that will bring the great "White Fathers" in Washington with more ropes to hamstring our greatest potential industry.

This problem harbors lots of trouble for service operators. They are powerless to do anything about it except to keep pounding away at other industry organizations urging them to take fast, concrete action toward a correction of the situation before it results in complete service chaos.

What Size TV Service Companies?

Amidst all of the confusion created by the impending defense demands of the industry, scare buying, and critical shortages of replacement parts and tubes, economic patterns for the efficient and profitable operation of independent service companies are becoming apparent. The editors of your *"NEWS"* department have been conducting an exhaustive survey of successful service business operations in all sections of the country. Our report to you will be carried in a feature article in the February issue of RADIO & TELEVISION NEWS. Watch for it. You will find it interesting.

TV Set Conversions

The best barometer of the great differences in the activities of independent service business operators in various sections of the country is reflected in what they are doing in the business of converting television receivers. This business was a lifesaver to many of the smaller service contractors in metropolitan areas last Spring when the battle for installation and service business got rough. And it was a boon to the larger contractors in keeping their organizations busy during slack periods.

Yet in many cities independent service operators have been indifferent to the stable business possibilities of the television conversion business. Some said they had converted one set and found they could not handle the business at competitive prices. Others had paid no attention to it.

The conversion of television receivers is a long-range business activity. Where we are now converting from 7", 10", and 12" picture tubes to the currently desirable larger sizes, we are also establishing a user acceptance

Dear Om: Wondering what to do with your excess tubes?

Send list of quantities and types.

I'll buy all types of new tubes in small or large quantity and pay you highest cash offer.

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All yours to get you started on your own radio. $1.00 Deposit with C.O.D. orders. You pay postage. Send only $2.95 and we will pay postage.

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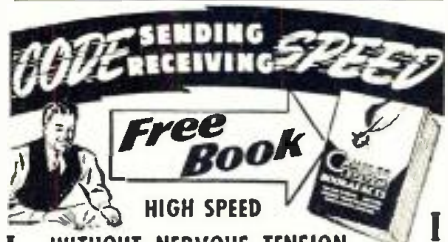

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REVEALING BOOK shows how "crack" operators develop high speed and proficiency. Learn code for Amateur or Commercial Radiotelegraph License, or improve your sending and receiving with the Candler System which develops radiotelegraph experts and code champions.

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pattern for changing receivers to adapt them to the latest developments in the art. Color? Sure. Quite a number of technicians have converted 7" sets to receive the CBS color transmissions.

The secret of profitable television receiver conversion business for the small operator is in specializing in one make of receiver and size of picture tube at a time. Once you have solved the "mechanics" of converting a particular type of receiver in your shop and have determined the cabinet changes that must be made, you can set up a simple "conversion line" and handle this type of receiver profitably.

If you are not a good "customer contact man" yourself you will have to get someone to solicit the business for you. Conversions are not hard to sell.

What Do You Do?

The question we are asked most often about customer relations is this: "How do you handle a customer and get him to pay for trouble he caused by tinkering with his TV receiver without making him mad?"

For many years one of the basic faults of radio service operators in dealing with customers was the tendency to assume an almost apologetic attitude in quoting prices for service work or in telling a customer frankly all of the parts that should be replaced to put his receiver in first-class playing condition. Maybe it was because we were selling our service time in competition with $9.95 a.c.-d.c. sets; or perhaps it was caused by our own feeling of inadequacy to turn the stuff out faster. Regardless of its cause it was an almost universal trait among service operators. They thought so little of their own abilities as business men that they applauded speakers who told them how lousy they were!

The men who have become successful television service operators have built their businesses on the sound thesis that customers are justly entitled to receive the service they pay for but only the service they *pay* for.

Good customer relations are an essential element in any successful television service business. One of the most useful booklets for establishing sound customer relations with TV set owners that we have examined is the booklet published by the Better Business Bureau of New York called "Things you should know about the purchase and servicing of Television Sets." It is written for the TV receiver purchaser and owner and it sets out clearly what the user has a right to expect and what he is *not* entitled to receive.

If you do not have a satisfactory television user booklet available for distribution in your town you should get a couple of copies of this booklet and carry one of them with you whenever you call on your service customers. You can get these booklets at a cost of ten cents each from the Better Business Bureau. Here is the address: The Better Business Bureau of New York, Inc., 280 Broadway, New York 7, N.Y. -30-

BC-223 TRANSMITTER

30 Watt transmitter with Crystal or MO control on four pre-selected channels. CW, MCW cover frequency range 2000-5200 KC, by use of plug-in coils. Complete with tubes and choice of one Tuning Unit (listed below). Less Mtg. -Prices:
NEW: $29.95
USED: $23.50

CABLE—Trans. to Power Supply.....$2.00
TUNING UNITS: TU-17—2000-3000 KC.; TU-18—3000-4500 KC.; TU 25—3500 5250 KC. $3.50 EACH
SPARE TUBE KIT in metal box. f/BC-223...$4.95
OPERATING MANUAL for BC-223.....$2.00
PE-125 POWER SUPPLY f/BC-223—12/24 Volt input; output 500 Volt 150 MA.....NEW: $9.95
SPARE VIBRATOR & TUBE KIT f/PE-125...$4.95
SHOCK MOUNTING for PE-125.....$1.50

BC-375 TRANSMITTER

BC-375 Transmitter—100 Watt Voice, CW, MCW covers frequency range 200 KC. to 12 MC. by the use of Plug-in Tuning Units, as listed below. Complete with tubes, less Tuning Units.....USED: $18.95
TUNING UNITS FOR BC 375 OR BC-191 TRANSMITTERS (Listed Below).....$3.95 EA.
TU-5—1500 to 3000 KC. TU-9 — 7700 to 10000 KC.
TU-6—3000 to 4500 KC. TU-10 —10000 to 12500 KC.
TU-7—4500 to 6200 KC. TU-26 — 200 to 500 KC.
TU-8—6200 to 7700 KC. BC-306—Antenna Loading
FT-151 Shock Mounting for BC-375-191.....$2.00
CABLES F/BC-375-191 w/PL-64. 5ft. or 6' ea. end.....$2.00 EA.

PROP PITCH MOTOR for rotating 10 and 20 meter beams. Small size. NEW.....$14.95
TRANSFORMER for operating above motor from 110 V. 60 cycle. 24 V. Secondary.....$3.95

COMMAND TRANSMITTERS and RECEIVERS with SCHEMATICS

	USED:	NEW:
BC-453 Receiver—190-550 KC.	$11.95	
BC-454 Receiver—3 to 6 MC.	5.95	
BC-455 Receiver—6 to 9.1 MC.	6.95	
BC-457 Transmitter—4 to 5.3 MC.	5.95	$8.95
BC-458 Transmitter—5.3 to 7 MC.	5.95	8.95
BC-459 Transmitter—7 to 9 MC.	14.95	24.95
BC-696 Transmitter—3 to 4 MC.	14.95	24.95
T-20/ARC-5 Trans.— 4 to 5.3 MC		8.95
T-23/ARC-5 Trans.—100 to 156 MC		29.50

RECEIVER (MOBILE-BOAT-AIRCRAFT)

BENDIX RA-10 RECEIVER—8 Tube Set covering frequency range 150 to 1100 KC. and 2000 to 10000 KC in four bands by use of remote control unit. Set size 18⅜" L. x 10⅞" W. x 8⅝" H. Wt. 32½ lbs. Comes complete with remote control unit, dynamotor, and plugs. BRAND NEW.
Order RA-10 CA f/ 14 Volt DC operation. $49.95
Order RA-10 DA f/ 28 Volt DC operation.

3/4 RPM ANTENNA ROTATOR MOTOR

High torque, reversible motor—operates directly from 110 Volt 60 cycle by use of condenser. Light weight, quiet running, ruggedly built, positive stop, easily mounted. Normally operates from 110 Volt 400 cycle. Complete—with instructions. NEW.....$4.95
10 MFD 400 Volt Cond.. $1.00. SPST Momentary Switch. 35c. DPDT Momentary Switch, 75c. Resistor, 100 ohm 25 Watt. 50c. 4 Wire Cable. 5c per ft.

ATD TRANSMITTER

50 Watt. 540 to 9050 KC. MO control. CW and Phone complete with tubes. (4/6L6G. 1/813. 12SL7. VR105). 24 V. Dynamotor. Control Boxes. Spare Tubes. Parts, etc. BRAND NEW.....$150.00

TDQ TRANSMITTER

45 Watt. 115 to 156 MC. Crystal control, MCW and Phone complete with Tubes. 110/220 Volt 60 cycle Power Supply, and Instruction Book.
LIKE NEW.....$450.00

DYNAMOTORS:

INPUT	OUTPUT:	STOCK No.	PRICE
9 V. DC	450 V. 60 MA.	DM-9450	
@ 6 V. DC	275 V. 50 MA.	w/Blower	$3.95
12 or 24 V. DC	440 V. 200 MA. & 220 V. 100 MA.	D-104	9.95
12 V. DC	600 V. 300 MA.	BD-86	7.95
12 V. DC	330 V. 150 MA.	BD-87	5.95
12 V. DC	375 V. 150 MA.	BD-83	6.95
12 V. DC	1000 V. 300 MA.	RD-77	7.95

PERMANENT MAGNET FIELD DYNAMOTORS:

12 or 24 V. DC	275 V. 110 MA.	USA/0516	$3.95
12 or 24 V. DC	500 V. 50 MA.	USA/0515	2.95
@ V. DC	240 V. 50 MA.		

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24 V. ½ amp. .$1.50
24 V. 4½ amps.. 3.95
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65 Foot length...$4.95
50 Foot length... 3.95
35 Foot length... 2.95
Junction Connectors for PL-259's.....75c

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MAST BASES—INSULATED:

MP-132—(Illustrated) 1" heavy coil spring, 2" insulator. Overall length: 11½". Weight 2¾ lbs. Price.....$3.95
MP-22—Spring action direction of bracket. 4"x6" mounting. Price.....$2.95

MAST SECTIONS FOR ABOVE BASES:

Tubular steel, copper coated, painted, 3 foot sections, screw-in type. MS-53 can be used to make any length, with MS-52-51-50-49 for taper.
Price—any section .....Ea. 50c
MS-54 or 55. Larger sections than MS-53...Ea. 75c
BAG BG-56 for carrying 5 Mast Sections..... 50c

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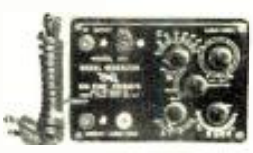
MODEL 101 SUBSTITUTION TESTER

Has test speaker with voice coil, transformer connections, range of resistors, paper, ceramicon, electrolytic condensers, variable pot. — and a simple signal tracer—can be used as audio signal tracer for radio & TV.
Dealers' Net..... $17.95



MODEL 103 SIGNAL GENERATOR

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New invention for TV testing, widely endorsed by experts. Supplies own sync. and sweep pulses for signal tracing sync. and sweep circuits with or without test pattern, scope, or bench equipment!
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Within the Industry
(*Continued from page 24*)

division has been made known . . . **GEORGE TALLENT** has been elevated to the post of manager of quality control, semiconductors, *CBS-Hytron* . . . *Magnetic Amplifiers, Inc.* has appointed **ROBERT O. BAXTER** assistant treasurer . . . **STEWART NELLIS** has been named sales manager of *Technical Wire Products, Inc.* . . . **DAN W. BURNS** and **ROBERT T. CAMPION** have been elected vice-presidents of *The Siegler Corp.* . . . **WILLIAM T. WELSH** has become vice-president and sales manager of *Cook Electric Co.* . . . **A. D. BOBROW** has been appointed director of automotive sales of *Van Norman Industries, Inc.* . . . *Zenith Radio Corp.* announces the appointment of **HAROLD F. DRISCOLL** as advertising manager . . . *RCA* has named **CHARLES M. ODORIZZI** as group executive vice-president, consumer products and services . . . *Sylvania Home Electronics* named **G. T. STEWART** manager of national distribution. —30—

ARMY MARS TECHNICAL BROADCASTS

Here is the January schedule for the First Army MARS SSB Technical Net whose purpose is the dissemination of technical knowledge by radio communication.

Transmissions are on Wednesday evenings, 9 P.M. (N. Y. Time, EST) on 4030 kc. upper sideband.

Jan. 7—"The Modern Approach To Front End Receiver Design" by M. M. Klein, Manager, Engineering, Research and Development, Lewyt Mfg. Corp.

Jan. 14—"TRAK—Morse Code To Tele-Printer Converter" by T. Waldron, Group Leader, Information Conversion Group, CGS Laboratories.

Jan. 21—"Phone Patches" by Robert W. Gunderson, Editor, Braille Technical Press.

Jan. 28—"Measurement of Nuclear and X-Ray Radiation" by William Minowitz, Physicist, Nuclear Products Division, Amperex Electronics Corp. —30—

Robert C. Sprague, right, chairman of the board of the Sprague Electric Company, is shown congratulating Harry Kalker, president of its subsidiary, Sprague Products Company, on its 25th Anniversary. The firm was founded under Mr. Kalker's direction in 1933 as the distributor division of parent organization. The actual Anniversary took place in the fall of last year.

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A. For Pocket or Purse, 2¾"x4¼"x1¼" $34.95
B. For Pocket or Purse, 2½"x4"x1¼" $34.95
C. For Shoulder Strap or Table, 3¼"x5½"x1½" $36.95

SYNCHRONOUS GEAR MOTOR
Haltzer-Cabot 60 RPM Geared Motor, 115 V., 60 Cy. 100 Oz. in Torque. Capacitor, short reversible motor. 4" square mounting. Shaft ¼". All NEW. Ea. $9.95

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Elmac 50 MMFD, 32 KV $5.95
G.E. 100 MMfd. 3 KV $1.95

BK-7 COCKPIT LITE
Bakelite Box 3" x 3¼" x 4¼" Lite assembly with 6 foot Retractable cord. NEW . . . . Ea. $1.00

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5 ohm— 10 watt 14c
85 ohm— 10 watt 14c
2500 ohm— 25 watt 17c
2500 ohm— 33 watt 20c
250 ohm— 50 watt, lamp base.....24c
105 ohm—100 watt, 4 taps.....48c
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20 MFD @ 350 VDC
2 x .25 MFD @ 600 VDC
.5—.5 MFD @ 100 VDC
3 x 1 MFD @ 400 VDC
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G.E. Oil Condensers—2-1-1-.12 MU .F 600 VDC 59c ea.

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CD307A with PL55 and JK26.....69c each
PL68 .....20c each
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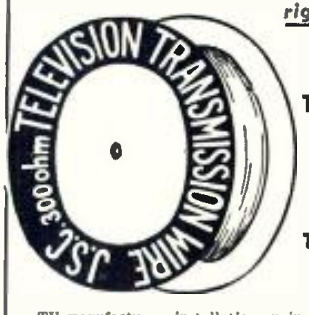

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115 VAC 60 cycle 15 tube 2 RF & 4 IF stages on one chassis 25"x11"x8" in a metal case with the following tubes and main parts PWR. trans. Thor. 70R62 chokes 4 Thor. 13C30 filter cond. 4 Aerovox 8-8 oil filled. RF & IF coils and tubes shielded. 2 plate tuning cond. has following tubes 1—955 5—954 4—6SK7 one for each stage IF 2—6SJ7 2—6N7 1—5T4 Rect. this is a super Het circuit each unit cost the Govt. $292.95 orig. tunes 195 to 210 megs we have converted one to 2 meters & plenty hot. orig. Print with ea. unit we furnish you with a print of our changes for 2 meters. all minor changes. Condensers are mica or silver mica Tubes except the acorns are metal. Check Feb. issue CQ 1946 for hot 10 meter write-up. This Hot 10 Meter Write-up with Print is Available free with ea. unit. The 115 VAC pwr. unit has four section filter capacitors and chokes in place of the usual one this can not be beat. These are a new lot just received, a large quantity in both the 406 and 406A, the only difference in the 406 and the 406A is there is a 115 VAC motor .65 RPM forward and reversible used for variable freq. control, this motor can be used for a geared beam plenty of torque 75 ounce inch units are later model with the same circuit and all like new. Send your order in early: send check or money order for the receiver but do not send the shipping charges: we will ship the units F.O.B. by freight, this is the greatest $ value on the surplus market; sold on a money back guarantee. Each unit with orig. print; we furnish conversion instructions and print for 2 meters and 10 meters free.

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APPROVED A200 Generator 100KC, 75MC, Precision 200 Tracer, Daco 606 Tube Tester, near new, with data. Sobey, 11814 McGowan, Cleveland 11, Ohio.

RT-18/ARC-1 VHF transceiver complete with antenna, cables, 9 crystals, etc. Tested and operating, $525.00. Flight Radio Sales, Municipal Airport, Cleveland 11, Ohio.

BARGAINS. New and reconditioned Hallicrafters, National, Collins, Hammarlund, RME, Meissner, other receivers, tuners, television receivers, transmitters, amplifiers, speakers, etc. Lowest wholesale prices. Terms. Shipped on trial. Liberal trade-in allowances. Write Henry Radio, Butler, Mo., and 11240 W. Olympic, Los Angeles, Calif.

HOTTEST surplus list in the country. Electronics-Hydraulics, Aircraft-Gadgets. Dick Rose, Everett, Wash.

RADIO Diagrams 50c; Record Changers, Recorders 60c; Television Diagrams with service data $1.00 up. State Manufacturer and model number. Kramer's Radio Service, Dept. RX, 36 Columbus Ave., New York 23, N. Y.

COLOSSAL bargain in radio parts, over 150 assorted radio parts including resistors, condensers, controls, coils, etc. All new, $75.00 value, guaranteed satisfaction or money refunded, postpaid in U. S. A., $2.50. Write for catalog. Buyers Syndicate, 30 N. Taylor St., Springfield 3, Mass.

RECORD Changer Parts for leading makes. We ship everywhere. Friend's Wholesale Distributors, 106 N. 6th St., Philadelphia 6, Pa.

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SURPLUS BC453, $12.95; BC457, BC458, $5.95 each; BC1206, $4.95; Jan transmitting, receiving tubes, other items, list free. Albert Arnold, Box 706, Amarillo, Tex.

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TCS 12 Transm. Rec. 110 volt A.C.; TCS 8 Transm. Rec. 12 volt A.C.; BC-191 Transmitter 12 volt A.C.; BC-348Q Receiver 24 volt D.C.; BC-221AK Modulated Freq. Meter; LM-15 Freq. Meter 110 volt; 50UFS Link Transm. Rec.; 1498 Link Transm. Rec. All complete, new, unconverted equipment. French-Van Breems, Inc., Chrysler Bldg., N. Y.

HIGHEST Bidder. Brand new TM54-APR4 2150 to 4000 mc., with schematics. W. C. Motz, 219 Elm St., Pittsburgh 18, Pa.

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53 OHM coax. prices reasonable. Inquire: Harry H. Van Dick, Little Falls, N. J.

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WANTED: APR-4 receiver and tuning units. State condition and price. W2DB, 274 Boulevard, Scarsdale, N. Y.

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AN/APR-1, other "APR-," "ARR-," "TS-," "1E-," ARC-1, ARC-3, everything surplus. Special tubes, Tech. Manuals, Lab. quality Test Equipment, etc. Describe, price in first letter. Littell, Farhills, Box 26, Dayton 9, Ohio.

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LANCASTER Allwine & Rommel Registered Patent Attorneys. Patent practice before U.S. Patent office. Validity and Infringement investigations and opinions. Booklet and form "Evidence of Conception" forwarded upon request. Suite 414, 815 15th St., N.W. Washington 5, D.C.

HERMAN Lewis Gordon, Registered Patent Attorney. Patent Investigations and Opinions. Warner Building, Washington, D. C.

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ERRATUM

Several errors occurred in the article, "Noise Reduction for High Quality Reproducing Systems" (Matthews), appearing on page 70 of the September 1950 issue of this magazine.

In Fig. 3 (page 72) the arm of the potentiometer R_{16} should be connected to the lower end of R_{18} at its juncture to C_{11}. R_{36}, which is listed as 5000 ohms, should be a 51,000 ohm unit.

Some readers have reported erratic behavior of the suppressor. This has been traced to the fact that an input of less than .1 volt appears at pin #1 of V_6. At least this voltage, but not over 1 volt average signal level, should appear at this point.

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0-5,10,50,100,500,1000,5000. Input impedance: 20 megohms (including 10 megohms in the DC probe)

AC VOLTS
0-5,10,50,100,500,1000,5000
Input impedance: 10 megohms

OHMS
0 to 1000 megohms in 6 ranges with center scale readings of 10,100,1000,10K,1Meg.,10Meg.

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50 MMF to 5000 MF in 6 ranges. Low voltage power source enables testing of electrolytic condensers.

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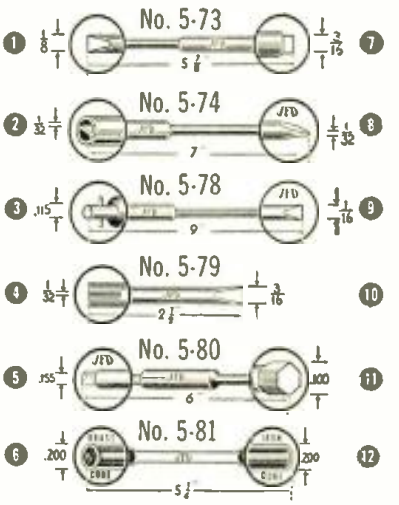

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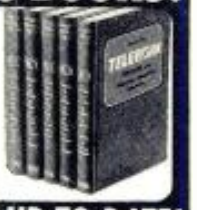

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VERNIER DIAL (From BC-221)
2¾" Dia. 0-100 in 360°. Black with silver marks. Has thumblock 85c

VERNIER DRUM (From BC-221)
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Octal Base Pentode A versatile High Perveance Tube. New **35c**
5 for $1.50

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Prong Mount
D. Y. Type

MFD	Volt	Price
8	450	.25
30	450	.29
30	300	.25
40	450	.30
8–8	450	.40
10–10	450	.40
24–24	400	.45
40–40	400	.70
80–50	450–50	.69
50–40	300–250	.60
80–10	450	.69
250	10	.98
1000	6	
20–10	350–300	.40
10–10	450	.29
20	25	
10–30	450–400	.59
30	300	
10–15	350	.49
20	25	
10–50	350–100	.69
100	50	
20–20	400	.69
20	25	
20–10	450	.59
50	50	
20	150	.79
250–100	15	
40–40	450 150	.79
130	50	
40–40	450	.69
20	25	
50–50	150	.49
40	25	
50–50	200	.69
40	25	
80–40	400	.79
150	50	
90–90	200	1.10
20	50	
120–60	150	1.10
20	25	

Many Others Write for List

AUDIO TRANSFORMERS

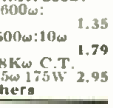
ITEM	DESCRIPTION	PRICE
AT666	Input 6ω:250KΩ	$0.79
AT Sub.	Multimatch Subminiature 200ω:15KΩ C.T.:100KΩ/20KΩ	.69
AT070	Input to Grid. 250ω: 60KΩ HI FI	1.19
AT566	Input to Grid, 50/200ω 50KΩ	.95
AT227	Output to Line 7500K:500ω C.T. 200-5KCy	1.45
AT353	Output PP 6L6 to 300/20/12/16ω 25 watt	2.95
AT871	Univ. Output, HI FI, Pri. 20KΩ CT/16KΩ CT/5K/4KΩ. Sec 15/7.5/5/3.75/1.25/500ω	2.79
AT554	Interstage 10KΩ: 250Kω 15db Level	1.95
AT765	Input 600ω to 50Kω	.79
AT707	Interstage Ounceer 10KΩ:125K/125Kω	.79
AT750	Input Pri: 15/15ω. Sec:18KΩ	.59
AT449	Driver 5KΩ to 4KΩ P1G6L6 to PP805 Class B	3.89
AT21	Dual XFRMR 300ω: 300ω and 600ω: 250KΩ	1.35
AT083	Output 8500ω:10ω 25W	1.79
AT415	Output 18KΩ C.T. to Line 125ω 175W	2.95

Many Others

Heneman Ckt Bkrs for AC-DC operation.

AM1510M	7 AMP
1614	80 AMP
1614	50 AMP
U90	100 AMP

Price ea. $1.10
P-6422 Dual 10 Amp. Price ea. $2.25



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926—C15
926—C13
926A—14
926C—16
926B—7
929—1
926B—16
926A—14
926A
11c ea. 100 for $10.50
1000 for 10c ea.

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1ω	
2ω	
10ω	
12ω	
15ω	
20ω	
25ω	
50ω	
90ω	
120ω	
180ω	
200ω	
300ω	
350ω	
360ω	
375ω	
400ω	
500ω	
700ω	
750ω	
1000ω	
1500ω	
1700ω	
2200ω	
3000ω	
5000ω	
6000ω	
7000ω	
7500ω	
10,000ω	
15,000ω	
20,000ω	
25,000ω	

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CH791	Dual 1.75—.125HY 100MA	.59
CH917	10HY .450A	12.95
CH10C	20HY .060A	1.10
CH86C	Dual .01–3.5HY 950–75MA	1.10
CH081	15HY .110A	1.59
CH19-1	20HY 80MA	1.49
CH921	7HY .900A	29.00
CH22-1	1HY .100A	.49
CH779	.6HY .490A	.69
CH25A	SW .09/.01HY 3/.3A	8.95
CH1528	20HY .100MA	1.69
CH922	10000HY 0MA	2.75
CH043	2.2HY 80MA	.59
CH047	2HY 200MA	.79
CHC29	SW15/29HY 150A	3.25
CH867	1.8HY .180A	.95
CH323	2.1HY .200A	1.95
CH360	15HY 15MA	.98
CH7A-1	.577HY 7.7MA	1.79
CH791	1.75HY .100A	.59
CH161	Dual 30HY .020A	.98
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CH21-A	.045HY .900A	1.69
CH045	5HY .040A	.35
CH884	.01HY 2.5A	1.45
CH136	25HY 80MA	2.25
CH381	14HY .250A	9.95
CH702	6HY .150A	.99
CH163	25HY .070A	1.25
CH116	.030HY 2A	1.39
CHC52	10HY .600A	12.95
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CH756	30HY 25MA	.79
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CH366	20HY .300A	7.95
CH110	25HY .065	1.00
CH480	.333HY 1.12A	2.29
CH189	120HY 17MA	2.49
CH89A	Dual 1.52HY .167A	1.95
CH14A	.100HY 1.4A	1.95
CH012	51IY .300A	1.95
CH382	51IY .150A	1.45
CH246	15HY .100A	1.39
CH141	Dual 7-11IIY 75-60MA	1.29
CH961	Dual .22-.441IY .6-.4A	1.75
CH351	.033HY 7A	15.95
CH583	.116HY .150A	19.95
CH1A1	.5HY 100A	.79
CH007	3.5HY .500A	4.95

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TU5	1500— 3000KC.	
TU6	3000— 4500KC.	
TU7	4500— 6200KC.	
TU8	6200— 7700KC.	
TU9	7700—10000KC.	
TU20	200— 500KC.	

Price $2.49 ea.

TUNING UNITS FOR BC 223 XMITTR

TU17A	2000-3000Kc.
TU18	3000-4500Kc.
TU25	3500-5200Kc.

Price $2.50 ea.

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Screen Mod. XFRMR for pair of 807's PP — PP or Parll Sidetone Wnd'g. 95c

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Mod. XFMR P-P 807 to P-P or PAR 807's #9446 $1.65

6V Input Dynamotor
Output 150V/75MA or 12V Input. 500V/50MA Out.
$3.49

T. U. for BCAR230 or 430
3.2—4MC
5—6.2MC
1.2—1.5MC
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4—5MC w/ 4495KC
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ARC 5 MODULATOR
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2 MFD 600VDC 49c
14 MFD 330VAC 1000VDC ..$3.95

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SOLAR XMB
TAPPED POLES

Mld.	Price
2500 V Test	
.00001	$0.35
.000025	.35
.00003	.35
.00005	.35
.000075	.35
.0001	.35
.00015	.35
.0002	.35
.0003	.35
.0004	.35
.0005	.40
.00075	.40
.0008	.40
.001	.50
.0015	.50
.0016	.50
.0017	.55
.002	.65
.0023	.65
.003	.75
.004	.95
.005	.95
.006	.98
.0063	.98
.0068	.98
.007	.98
.0075	.98
.0076	.98
.008	1.05
.01	1.25
.015	1.25
.02	1.30
.025	1.30
.027	1.35
.03	1.45
5000 V Test	
.0015	1.75
.002	2.00
Solar XQ Solder Lugs 2500 V Test	
.01	1.25
.015	1.30
.02	1.50
.04	1.75
.001	.60
.0015	.60
.002	.75
.0022	.75
.0023	.75
.0024	.75
.0025	.75
.0027	.80
.003	.80
.004	.85
.005	.90
.0056	.95
.006	.95
.0063	.95
.0075	1.00
.0076	1.00
.008	1.05
.0085	1.20
.0005	.60
.00085	.70
.00015	.60

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Item	H.V.	Amp.	Filaments	Price
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CT-142	645VCT	.060	5V/2A, 6.3V/1.2A	4.25
CT-825	360VCT	.340	6.3VCT 3.6, 6.3VCT/3A	3.95
CT-076	600V	.100	2 x 12.6V/1	1.95
CT-626	1500V	.160	2.5/12, 30/.100	9.95
CT-15A	350VCT	.070	6.3/.6, 6.3/1.8 3 lbs.	2.95
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CT-367	580VCT	.050	5VCT/3A	2.25
CT-721	550VCT	.100	6.3/1, 2.5VCT/2	2.95
CT-99A	2x110VCT	.010	6.3/1A, 2.5VCT/7A	3.25
CT-91A	726V	.100	5V/3A, 6.3/3.5	3.25
CT-080	700VCT	.205	5V/3, 5V/2A	3.95
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CT-866	330V	.065	6.3V/1.2, 6.3V/600 MA	1.75
CT-319	330VCT	.085	5V/2. 6.3/7.5, 6.3 .3	3.25
CT-526	510VCT	.025	12.5/.900 MA, 6.3/.5A.	1.95

Filament Transformers—115V/50-60 cps input

Item	Rating	Each
FT-852	23V .35	$1.79
FT-30B	58V/2.2A	2.25
FT-599	78V/.300, 6.3V/2A	1.95
FT-719	1.3V/6A	.79
FT-029	13.5V/1.11A	.79
FT-074	2.5V/10A, 6.3/.9A	1.79
FT-23-1	6.3V/3A	1.10
FT-346	5VCT/13/5, 5VCT/6.75, 5VCT/6.75	5.95
FT-781	866 Trans. 2 x 2.5/5A	2.25
FT-36-4	6.3/2, 6.3/4.5	1.49
FT-511	3.4V/300A, 7½H x 10" x 5"/2W	14.95
FTG-31	2.5V/2.5, 7V/7A (Tape @ 2.5V/2.5A), 16 lbs.	9.95
FT-674	8.1V/1.5A	1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-391	6.4V/3A	1.10
FT-736	2 x 6.3VCT/3.2-1.2A	1.49
FT-461	2 x 6.3VCT/1A	1.10
FT-899	2x5 V/5.5A 29000 Rms.	12.95
FT-418	6.3VCT/1A, 6.3VCT/7A	1.95
FT-735	6.3VCT/5A, 6.3VCT/1A	1.79
FT-101	6V/.25A	.79
FT-738	6.3VCT/1A, 5V/2A	1.69
FT-774	6.3V/16A	.79
PT-589	9V/1.6A	.49

Plate Transformers—115V/50-60 cps input

Item	Rating	Each
PT-976	Auto: 120VCT/10 MA.	$ .69
PT-31A	2 x 300V/5 MA	.79
PT-46A	4080VCT N.L. 3% to 1 8" H x 6" W x 7" L 20 lbs.	29.95
PT-033	4150V/400 MA 11½ x 9¼ W x 9" D 70 lbs.	49 95
PT-75-2	3780/3446/3112VCT/77 MA	10.95
PT-28-1	4600VCT/.077	12.95
PT-403	Auto: 70V/1A	2 29
PT-160	1120VCT/770 MA, 590VCT/82 MA, 25 lbs.	24.95
PT-170	Auto: 156/146/137/128—.71A	3.29
PT*848	3140VCT/750 MA for BC545, BC1069A	69.95
PT-139	42V/46V/50V/55V/15.2A 7⅛x7" W x 6¼" H	10.95
PT-637	400V/20 MA	.98
PT-67-1	62V/3.5A	2.95
PT-12A	280VCT1.2A	2.95
PT-104	690V/450 MA	4.95
PT-054	980V/450 MA	5.25
PT-997	78V/.00754 KVA..... AUTO	1.49

SPECIAL TYPES

Item	Pri.	Output	Price
STF-946	210/220/230	2.5V/4A 3½" H x 2¼" x 2¼" D	$1.29
STF-443	220/440	11VCT 125A 6½" L x 6¼" x 8" 15 lbs.	15.95
STF-638	230	5V/9A 5½" H x 4½" x 3¼"	1.25
STF-05A	115/230	2 x 5V/7.5 7" H x 7" x 5" D	4.25
STF-682	220	30-25-20V/1 MA	.69
STF-968	230	2 5V/6.5A	1.10
STF-405	230/115	5V 12/9A	2.95
STF-370	220/440	3 x 2.5V/5A, 2.5V/15A, 5½ x 5 x 4½	5.25
STF-619	110/220	2.5V/500A, 7 x 5¼ x 5	19.95
STF-11A	220	2 x 40V/.05/2 x 5V/6A, 12 6/1A	2.95
STF-631	230	2 x 5V/27A 2 x 5V/9A. 103/4H x 5 x 7 30 lbs.	24.95
STF-608	220	24V/600, 5V/3A, 2 x 6 3V/1A	2.25
STF-45A	43/78/90 115/180/230	2 x 2.5/6.5. 6.3V/4 ? Few.	3.25
STF-306	100/120 200/240	5VCT 10 amp 20000 V Test	13.95

SPECIAL PLATE TRANSFORMER

STP-945	210/20 30	1100VCT/300 5¼ x 4 x 3½	$5.95
STP-444	230/460	230/105/115/125 15 lbs. 5¼ x 6 x 4½	14.95
STP-613	230V	2 x 230/.05	1.29
STP-823	137V	222VCT/300 MA	2.95
STP-780	82V	4000V/.002	1.29
STP-088	50V	2 x 750V/1 MA	.98
STP-311	30/35 40	95 NL-50VFL .1 Amp. COMB.	.59
STC-627	230V	1500/160, 110V/.200, 3.3V/.200, 5V/10, 2.5-1 4/10	$5.95
STC-611	230V	200V/200, 4 x 6.3V/.9	2.95
STC-16A	220V	260V/.03, 100V/1, 6.3V/4.2	2.95
STC-607	220V	700VCT/75 MA, 40VCT/.100, 15/10/15V/100 MA	3.95
STC-612	230V	400V/.30, 190/.30. 2 x 5V/2.5 w/2-866 Socket	3.95
STC-622	230V	250V/100, 2 x 5V/2-9 2-4 Png. Sockets	4.25
STC-047	200V	700V/80 MA, 110/.80 MA, 24V/80 MA, 2 x 6.3/.3-1A, 5V/3. 5V/5A. 2.7/5A	4.95

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MFD	VOLT	TYPE	EACH	10 FOR
.5	600	2ST	$ .25	$2.40
.5	400	2BT	.23	2 20
.5	600	2TT	.25	2.40
3X.1	600	3TT	.45	4.35
3X.1	600	3ST	.45	4.35
2X.1	400	3ST	.26	2.50
2X.1	600	3ST	.28	2.65
2X.1	600	3BT	.28	2.65
2X.1	400	2TT	.26	2.50
2X.1	200	2ST	.23	2.20
2X.1	600	2BT	.26	2.50
2X.1	600	3TT	.26	2.50
.1-.1-.025	400	3ST	.28	2.65
.1	600	2BT	.22	2.10
.1	600	1ST	.22	2.10
.1	600	2TT	.22	2.10
.1	600	2ST	.22	2 10
.13	600	2ST	.25	2.40
2X.25	600	3ST	.30	2.85
.05	600	2TT	.21	2.00
1	100	2TT	.23	2.20
20	50	2ST	.26	2.50

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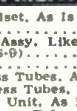

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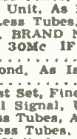

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0A3/VR75	1.28	2C43	28.50	6AG7W*	3.69	6N6	2.11	7R7*	1.18	RK20A	2.50	71	1.00	703A	3.98	1626	.49
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0B2	1.88	2C44	1.20	6AE5	.29	6N7GT	1.26	7T7	1.03	PJ22/CE1C.	1.49	CRP72	1.37	705A/8021	.65	1631	.80
0B3/VR90	3.59	2C50	3.69	6AE6G	.79	6P5GT*	1.26	7V7	1.33	22	.99	73	1.67	707B	13.50	1632	.77
0C3/VR105	1.03	2C51	5.69	6AF5G	.89	6Q7	.89	7W7*	2.65	24	.89	NR74	.29	707B	24.98	1633	.75
0D3/VR150.	.85	2C52	3.00	6AF7	1.33	6R7	1.33	7X7*/XXFM.	1.33	HY24	1.19	75	.83	710A/8011	.79	1634	1.35
0Y4	2.33	2D21	1.15	6AG5	2.65	6R8	1.19	7Y4*	.90	24A	1.10	76	.83	713A	1.00	1635	1.49
0Z4	.88	2E5	1.15	6AG7*	2.65	6S4*	1.80	7Z4*	.95	24G/3C24	.69	77	.83	715A	6.98	1641/RK60	.75
C1A	4.90	2E22	1.15	6AH5G	1.49	6S7	1.29	10Y	.29	25A6	1.20	78	.83	715B	7.98	2050	1.80
01A	.68	2E24	4.50	6AH6*	3.90	6S8GT*	2.65	12A	.89	25A7	3.27	79	.89	715C	22.98	2051	.89
1A3	1.10	2E25/HY65.	4.20	6AK5*	1.33	6SA7GT*	1.26	12A5	1.39	25AC5GT	1.95	80	1.19	717A	.61	R4340	36.00
1A4P	.98	2E26	3.34	6AK6*	2.40	6SB7Y*	1.20	12A6*	.98	25B5	1.39	81	1.95	720CY	45.00	5514	4.85
1A5GT	.85	2E30	2.25	6AL5	1.00	6SC7*	1.00	12A7	1.49	25B6	2.49	81A	1.95	721A	2.19	5517	1.70
1A6	1.78	2E32	10.65	6AL5W*	2.00	6SD7GT	1.29	12A8GT	1.00	25B8GGT*	3.20	82	1.29	722A/287A	2.75	5517/CK1013	1.89
1A7GT	1.06	2J21A	10.65	6AL5W*	2.90	6SF5	.93	12AH7GT	1.33	25C6	1.18	82V	1.39	723A	6.95	5618	3.29
1AE4	1.80	2J22	9.45	6AL7GT	2.65	6SF7	.98	12AL5*	2.00	25L6GT	.87	83	1.29	723A/B	14.98	5656	9.98
1B3/8016*	2.65	2J26	6.98	6AN5G	2.00	6SG7*	2.20	12AT6*	1.50	25N6	1.69	83V	1.39	724A/B	2.89	5670	5.98
1B4P	.98	2J27	13.79	6AN8G	.89	6SJ7*	1.85	12AT7*	2.90	25W4GT*	2.00	84/6Z4	.95	725A	6.39	5675	4.23
1B5/25S	.98	2J30	39.50	6AN8*	1.23	6SK7GT*	1.80	12AU6*	2.00	25Y5	1.45	85	1.10	726A	7.98	5812	2.99
1B7GT	.98	2J31	8.90	6AQ5*	1.80	6SL7GT*	1.80	12AU7*	2.40	25Z5	.87	89	.79	726C	39.98	UX6653	.69
1B21/471A.	2.85	2J32	12.80	6AQ7GT	1.23	6SN7GT*	1.80	12AV6*	1.50	25Z6GT*	1.50	VR92	.25	730A	9.89	8002R	99.50
1B22	3.49	2J33	16.48	6AR5*	1.98	6SN7GTA*	2.20	12AV7*	3.20	26	.79	100th	8.99	801A	.29	8012A	1.25
1B23	8.50	2J37	19.34	6AS5	1.39	6SN7WGT*	2.90	12AW6*	2.65	27	.73	801A	17.49	803	4.39	8020	3.75
1B24	4.39	2J38	95.00	6AS6	2.00	6SQ7GT*	1.50	12AX7*	2.40	FG27A	8.70	FG105	8.69	803	3.00	8020	1.29
1B26	3.69	2J37	12.80	6AS7G*	6.75	6SR7*	1.50	12BA6*	1.80	RK28A	2.85	VU111	.45	804	8.45	9001	1.98
1B27	23.83	2J38	9.99	6AS8	1.50	6SS7	.90	12BA7*	2.40	RK28D	1.39	HY114B	.79	805	3.59	9002	1.65
1B29	.98	2J39	19.90	6AT6*	1.50	6ST7	1.90	12BE6*	1.80	30*	.89	HY115/145	.75	807	2.39	9003	1.98
1B32/532A.	1.79	2J40	24.50	6AU5GT*	2.65	6ST7	1.33	12BF6	.85	HY31Z	2.75	117L7*	1.98	808	1.35	9004	.79
1B36	10.00	2J48	15.70	6AU6*	2.00	6SU7GTY	3.37	12BH7*	2.40	32	.59	117N7GT	1.95	809	2.45	9005/RC4B.	1.95
1B37	18.00	2J49	39.48	6AV5GT*	2.65	6SV7	1.48	12C8	1.39	FG32	5.98	117P7GT	1.95	810	11.96	9006	.27
1B38	34.00	2J50	27.50	6AV6*	1.50	6SX7	1.48	12F5	.90	32L7GT	1.69	117Z3	.79	811	2.89	C'Ray Tubes	
1B40	4.95	2J55	89.25	6AW6*	2.65	6T7G	1.29	12H6*	1.80	FG33	8.90	117Z6GT	1.45	812	2.60	2AP1	4.85
1B41	49.95	2J56	249.50	6AX5GT*	1.25	6T8*	2.90	12J5GT*	.75	34	1.00	117Z6GT	1.20	813	11.75	2AP5	7.98
1B42	7.50	2J62	49.48	6BA6*	1.80	6U4GT*	1.25	12J7GT	1.00	35/51	1.00	117Z7GT	1.48	815	1.37	3AP1	4.69
1B46	3.69	2K25	24.95	6BA7*	2.40	6U5/6C5*	1.05	12K7GT	.98	35A5	.95	F127A	15.89	826	.39	3BP1	2.49
1B53	49.95	2K26/mtd	36.98	6BC5*	2.00	6U6GT*	1.80	12K8	1.07	35B5*	2.00	CV148	4.98	SD828	.98	3BP1A	1.98
1B54	79.00	2K28	29.95	6BC7*	2.00	6U7G	1.39	12Q7GT	.90	35C5*	2.00	150T	14.50	829	7.25	3CP1-S1	2.20
1B56	40.95	2K39	89.50	6BD5GA*	3.20	6V6*	2.25	12S8GT	.98	35D5*	2.00	15S	.98	829B	12.50	3DP1	3.00
1B59	12.95	2V3G	1.29	6BE6*	1.80	6V6GT*	2.00	12SA7GT*	1.05	35L6GT*	1.65	FG166	49.00	832	7.98	3DP1-S2	4.65
1B60	64.95	2W3GT	.98	6BF5*	1.80	6V6GTY*	2.45	12SC7	1.10	35W4*	1.25	FG172	29.50	832A	10.64	3EP1	2.45
1C5GT	1.09	2X2	.89	6BG6G*	.98	6W4GT*	1.20	12SF7GT	.79	35X4	.90	182B	1.20	833A	33.98	3EP1	1.60
1C6	.98	2X2A	1.49	6BH6*	1.50	6W4WGT*	2.50	12SG7	.89	35Z3	.90	FG190	12.80	836	1.98	3FP7A	14.98
1C7G	.98	3A4	.69	6BJ6*	1.80	6W5GT*	1.10	12SH7	1.10	35Z4GT	.90	205B/VT2	1.69	837	1.39	3GP1	4.89
1D5GP	.98	3A5	1.29	6BK5*	2.00	6X4*	1.50	12SJ7GT	.89	35Z5GT*	1.50	CE206	3.15	838	2.35	3HP7	2.85
1D7G	.98	3A8GT	1.98	6BL7GT	1.39	6X5GT*	1.25	12SK7*	1.80	REL36/6J4	.50	211/VT4C	.45	842	2.75	3HP14	1.98
1D8GT	.98	3B4	2.89	6BN6*	1.80	6Y5	1.85	12SL7GT	1.07	36	.69	RX215	9.95	843	.39	3JP1	15.00
1E5GP	.98	3B7	.98	6BQ5*	1.80	6Y6G*	1.65	12SN7GT*	2.20	37	.69	WE215A	.15	845	5.95	3JP12	19.95
1E7G	.98	3B7/1291	.69	6BQ6GT*	2.00	6Y7G	1.18	12SQ7GT*	1.50	38	.69	227A	2.65	851	29.98	4AP10	4.39
1F4	.79	3B22	2.45	6BQ7A*	1.80	6Z5/12Z5	1.18	12SR7	.98	39/44	.69	231	1.20	860	5.70	5AP1	3.59
1F5G	.98	3B24	3.98	6BR5*	1.80	6Z7G	.98	12X3	.90	CRC40	.54	249C	1.95	861	10.89	5AP4	2.25
1F6	.98	3B25	4.69	6BR6*	2.00	6ZY5G	.98	12Z3	.98	41	.79	250TH	18.75	864	.29	5BP4	4.50
1F7G	.98	3B27	1.98	6BS6*	1.80	7A4/XXL*	.98	14A4	1.29	42	.79	250TL	18.75	865	1.39	5CP1	1.75
1G4GT	.98	3B28	7.85	6BT6*	1.49	7A5*	1.10	14A7/12B7	1.08	43	.85	282B	8.49	866A	1.10	5CP7	3.39
1G5G	.98	306/XXB	1.60	6BW6*	2.25	7A6*	.90	14AF7/XXD.	1.18	45S/VT52	.22	HF300.304TH	9.98	866Jr	1.15	5FP7	1.28
1G6GT	1.19	3C23	5.85	6BX6*	2.00	7A7*	1.62	14B6	1.08	45Z3	.89	304TL	9.98	869	25.98	5GP1	5.25
1H4G	.98	3C31/C1B	3.98	6BY5G*	2.00	7A8*	.90	14B8	1.10	45Z5	.90	307A/RK75.	6.49	872A	2.98	5HP1	4.95
1H5G	.98	3C45	12.85	6BZ6*	2.00	7AB6*	2.00	14C5	.89	47	.89	316A	.69	874	.35	5HP4	2.75
1H6G	.98	3D6/1299	.69	6C4*	1.65	7AD7*	.98	14C7	1.20	48	3.90	323A	24.98	878	1.95	5JP1	39.95
1J5G	1.20	3D21A	1.98	6C5	.89	7AE6*	.90	14E6	1.10	RK48A	14.85	327A	2.50	884/6Q5G	1.45	5JP2	9.45
1J6G	.98	3E29	12.85	6C6	.89	7AF7*	.98	14E7	1.33	49	.89	350A	2.75	885	1.39	5LP7	19.98
1L4	.98	3E4	1.37	6C8G	.98	7AG7*	1.15	14F7	1.10	50	3.90	350B	2.25	920	2.70	5MP1	4.75
1LA4	1.33	3Q4	.98	6C21	24.95	7AH7*	1.16	14F8*	1.33	50A5	1.35	355A	14.15	922	.98	5NP1	1.98
1LA6	1.33	3Q5GT	1.11	6CB6*	2.00	7B4*	1.80	14H7*	1.20	50B5*	1.80	GL434	2.69	927	.70	7BP1	4.95
1LB4	1.33	3S4	.98	6CD6G*	6.00	7B6*	.90	14J7	1.33	50C5	1.03	446A/2C40	1.19	928	.39	7CP1	4.65
1LC5	1.33	3V4	2.98	6D6	.89	7B7*	.90	14N7	1.33	50C6*	1.49	WL446B	1.75	SD968	.98	12JP4	27.00
1LC6	1.33	4B27	4.98	6D8	.98	7C4/1203A	.89	14Q7	1.10	50L6GT*	1.65	RK50TH	39.95	991	.25	12KP4	47.00
1LD5	.98	4C33	59.00	6D8G	.98	7C5*	1.62	14R7	1.29	50X6	1.10	527	12.98	FM1000	1.50	12LP4	24.35
1LE3	1.33	4C35	34.90	6D9	.98	7C6*	1.62	14S7	1.33	50Y6GT	.90	GL530	49.69	R1100	5.00	20X672	2.95
1LG5	1.33	4C36	15.98	6D10G	2.39	7C7*	72.00	14W7	1.33	50Y7GT	.99	WLS31	3.75	R11308	12.00	189048GE	3.49
1LH4	1.33	4D32	12.95	6E5	1.75	7E5/1201	1.25	14X7	1.33	51	.99	GL534/1S21.	5.39	HY1231Z	5.39	8D4883	9.98
1LN5	.98	4E27/257	12.45	6E6	1.30	7E6*	1.80	14Y4	1.20	53	1.33	S44	4.98	HY1269	5.39	Xtal Freq.	Stds
1N5GT	.98	4J31	95.00	6E7	1.30	7E7*	1.10	15E	1.17	55	1.06	GL546	1.69	1273	1.15	100Kc	7.98
1N6G	.98	4J42/700	19.00	6F5	.83	7F5*	1.05	15R	.49	56	.85	S50P1	19.95	1609	5.98	200Kc	3.98
1P5GT	.98	4J47	260.00	6F6*	1.80	7F7*	1.33	FG17	3.98	58	.89	575A/975	12.65	1613/6F6X.	1.06	1000Kc	4.49
1P24	2.39	4J52	250.00	6F6GT*	.85	7F8*	1.33	RK18	.98	57	.89	601B	.19	1616	.75	4700Kc	.98
1Q5GT	.98	4T4/2	5.98	6F7	1.39	7H7*	1.33	18	.98	58	.89	HY615	.18	1619	.29	5000Kc	3.98
1Q26	69.00	5C22	59.98	6F8G*	1.49	7J7*	1.33	19	.89	59	1.78	WL619	18.90	1620	4.95	HtrOvenXtals	
1R4/1294	.98	5C30/C5B	9.98	6G6G	.98	7K7	1.33	19BG6G*	6.00	RK65	24.95	WL632A	8.98	1622	1.75	5010/5025/5055	
1R5	1.28	5D21	24.39	6H6*	.98	7L7	1.33	19J6*	3.20	HY69	2.75	701A	1.59	1624	1.05	Kc, Ea.	14.98
1S4	1.20	5J21	13.49	6J4*	6.98	7N7*	2.65	19T8*	2.90	70A7	1.59	701A	2.90				

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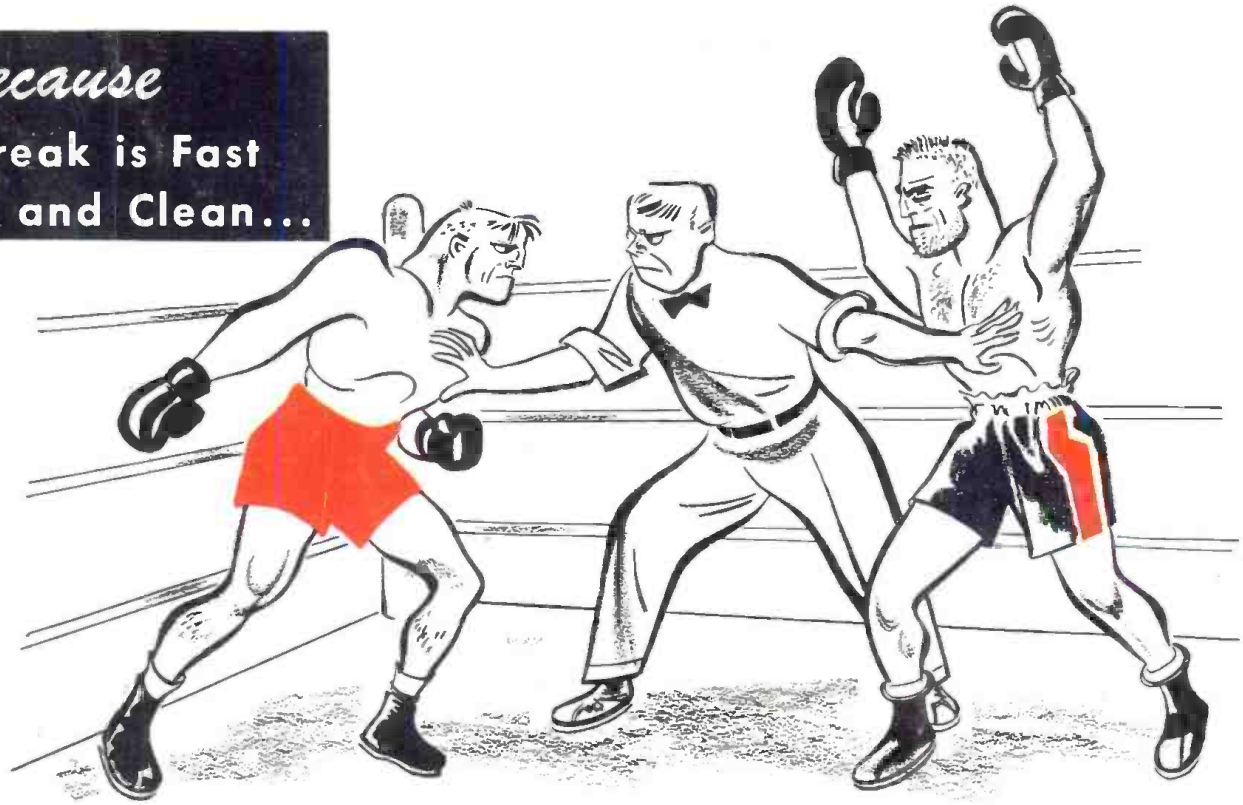

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